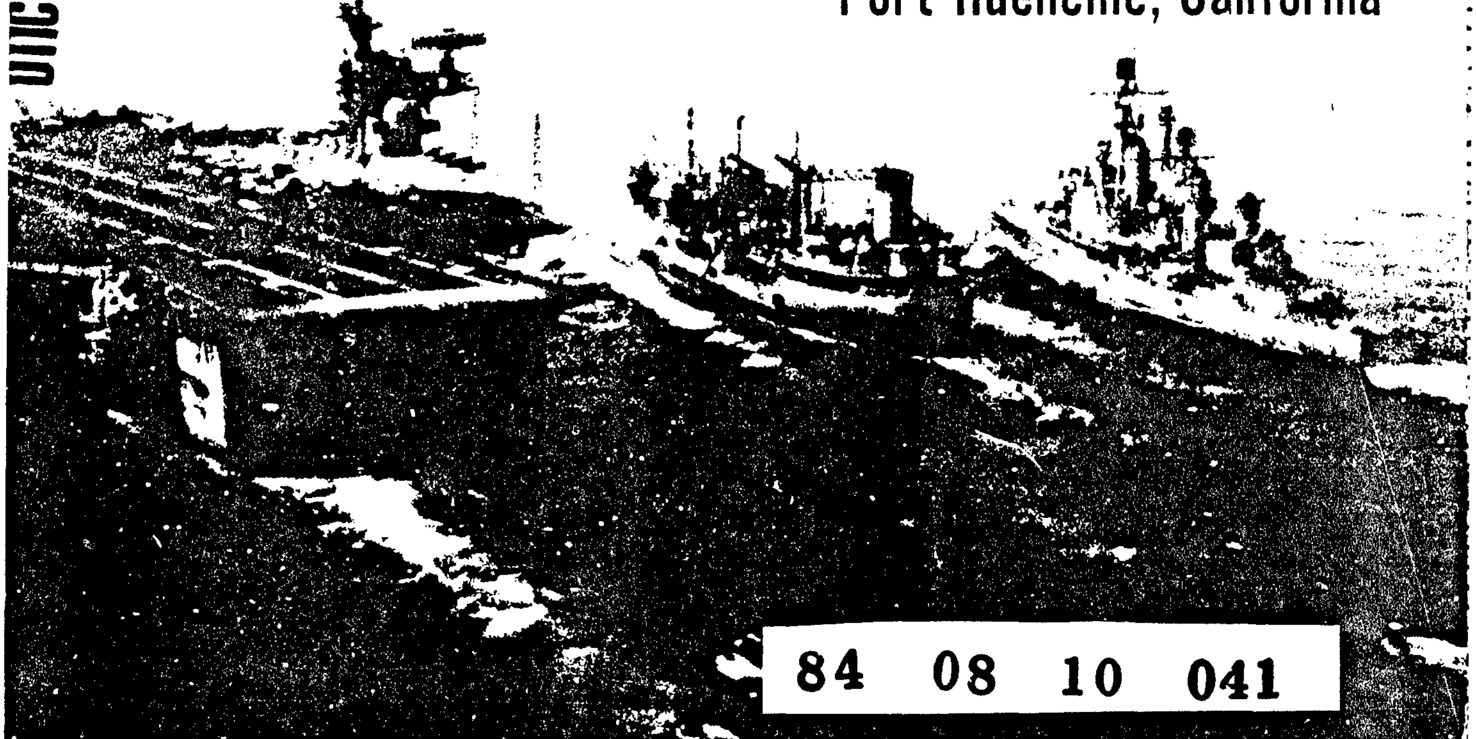
PROCEEDINGS 1983 SPRING MEETING

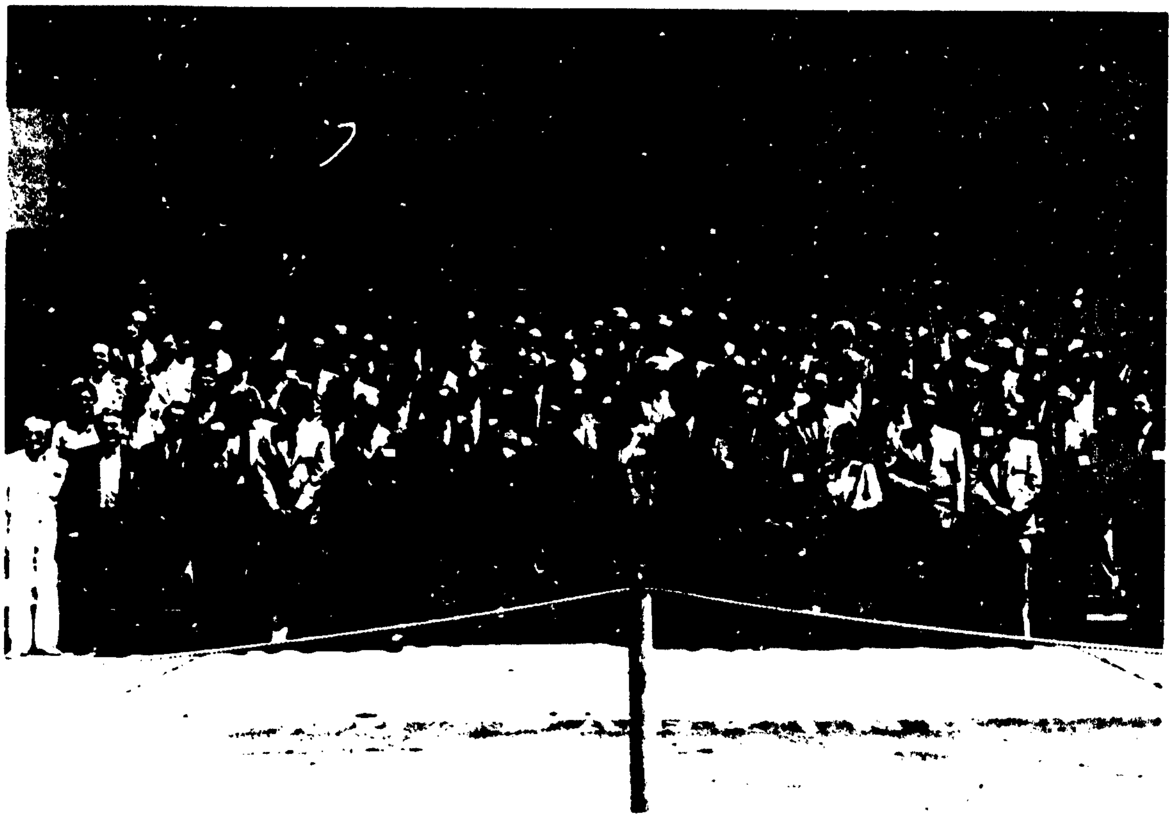
Packaging, Handling and Transportability Division

American Defense Preparedness Association

26-28 April, 1983

Naval Civil Engineering Laboratory
Port Hueneme, California





AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

DEDICATED TO PEACE WITH SECURITY THROUGH DEFENSE PREPAREDNESS

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FOREWORD

The 1983 Spring Meeting of the Packaging, Handling and Transportability Division of the American Defense Preparedness Association was held on April 26 - 28, 1983 at Naval Civil Engineering Laboratory, Port Hueneme, California.

We extend our sincere thanks to Captain James H. Osborn, CEC, USN, Commanding Officer, NCEL, Port Hueneme, for hosting the meeting and delivering the Welcoming Address and NCEL Technical Program Review.

We also wish to thank Captain Osborn for his very generous sharing of Mr. Dick Seabold's time to assure that the meeting would be a success.

Sincere thanks again to all speakers for their excellent presentations. Each provided important service to DOD agencies and Industry attendees in maintaining technical and management capability for packaging, handling and transportability.

This technical report contains the program agenda, a list of attendees, and the technical papers presented at the meeting.

1983 SPRING MEETING
PACKAGING, HANDLING & TRANSPORTABILITY DIVISION

AGENDA

APRIL 26, 1983

1330 P.H. & T. DIVISION BOARD MEETING - CASA SIRENA MARINA HOTEL
1700 REGISTRATION - HOTEL
1700 EARLY BIRD, NO HOST RECEPTION - HOTEL

APRIL 27, 1983

0730 REGISTRATION - NCEL, BUILDING 560
0800 BUSES DEPART - HOTEL TO NCEL
0900 MEETING CONVENES - NCEL, BUILDING 560
0915 WELCOME AND OPENING REMARKS - CAPTAIN JAMES H. OSBORN, CEC, USN, COMMANDING OFFICER, NCEL, PORT HUENEME
0930 NCEL TECHNICAL PROGRAM - CAPTAIN JAMES H. OSBORN
1000 COFFEE BREAK
1015 LOGISTICAL SUPPORT TO ADVANCED BASES - MR. DAVID LAMBIOTTE, PROGRAM MANAGER, ADVANCE BASES PROGRAM, NCEL
1045 OSD SPEAKER - COL. J.W. PATTY, USA, MILITARY TRAFFIC MANAGEMENT COMMAND, WESTERN AREA, OAKLAND, CA
1115 THE EFFORTS OF THE FMC ORDNANCE DIVISION TO INTEGRATE P.H. & T. INTO THE OVERALL ILS PLANNING EFFORT - MR. W. MORGAN AND MR. S. FURTADO, FMC CORPORATION, ORDNANCE DIVISION, ENGINEERING, SAN JOSE, CA
1200 LUNCH - HOTEL
1315 BRASS - 2000, APPLICATION OF HIGH TECHNOLOGY TO U.S. ARMY BATTLEFIELD LOGISTICS - MR. JOHN STEPHENS, HUMAN ENGINEERING LABORATORY, ABERDEEN, MARYLAND AND MR. MIKE DAVALL. ARMAMENT SYSTEMS, INC., ABERDEEN, MARYLAND
1345 ROBOTICS FOR MILITARY LOGISTICS SUPPORT - DR. T.M. KNASEL, SCIENCE APPLICATIONS, McLEAN, VIRGINIA
1430 COFFEE BREAK
1445 HAZARDOUS MATERIAL HANDLING, PERFORMANCE TESTING, ASSISTING IN CONTAINER DESIGN - MR. RALPH L. DAY AND MR. RON HINKLE, UNITED PARCEL SERVICE, GREENWICH, CONNECTICUT
1530 DOD HAZARDOUS MATERIAL, PACKAGING TRANSPORTATION CERTIFICATION - MR. DAVID R. VOLZ, ARMAMENT DIVISION, EGLIN AFB, FLORIDA
1630 BUSES DEPART FOR HOTEL
1830 RECEPTION - HOTEL
1930 BANQUET - HOTEL

APRIL 28, 1983

0800 BUSES DEPART - HOTEL TO NCEL
0900 NEW MATERIAL FOR ELECTROSTATIC DISCHARGE PROTECTION -
MR. HANK SMITH, H & S INDUSTRIES
0930 DESIGN FOR TRANSPORTABILITY OF OUTSIZED CARGO INCLUDING SHOCK AND VIBRATION ANALYSIS - MR. DOUGLAS D. HERMANSEN, TRW, REDONDO BEACH, CA
1000 COFFEE BREAK
1015 LOGMARS UPDATE - MR. FRANK GUERRERO, TRANSPORTATION AND PACKAGING DIVISION, DCASS, DEFENSE LOGISTICS AGENCY, CAMERON STATION, ALEXANDRIA, VIRGINIA
1030 BAR CODE EQUIPMENT DISPLAY - PRESENTATIONS BY:
DENNISON EASTMAN CORPORATION
WEBER MARKING SYSTEMS
LOGMARS SYSTEM 83
TELSCAN SYSTEMS, INC.
DMA COMMUNICATION, INC.
1230 LUNCH - HOTEL
1330 TOUR - NCEL

MANY THANKS TO OUR HOST, MR. DICK SEABOLD, NCEL

CL:sl

LOGISTICAL SUPPORT TO ADVANCED BASES

by David J. Lambiotte

Good morning, ladies and gentlemen. My name is Dave Lambiotte and I am the Program Manager for the Amphibious/Advanced Base Program here at the Naval Civil Engineering Laboratory. My goal here today is to spend the next half-hour giving you the flavor of our RDT&E Program - where we are going and what Navy or Marine Corps needs have pointed us in those directions.

The proponents of ~~our~~ this work are the United States Marine Corps engineer forces and the Naval Construction Force in which we include Mobile Construction Battalions, (MCB's) Amphibious Seabees (ACBs) and other elements of the Beach Group. Our parent organization is the Naval Facilities Engineering Command.

A large portion of our work is done in response to an amphibious scenario, usually in support of a notional Marine Amphibious Force (MAF), which can total about 50,000 people and be supported by a regiment of construction Seabees, a battalion of ACBs and other Navy beach group elements. We also respond, however, to the Seabee mission to construct advanced bases, whether they be expeditionary bases or more conventional facilities at places like Rota, Spain or Sigonella, Sicily.

I could rattle off a long list of words that describe the engineering and logistic capabilities and other "ilities" that we are after here, but let me limit them to three critical ones - Mobility, Versatility, and Effectiveness. The Marine Corps plans to use high mobility to effect local surprise and engage the enemy in a minimally defended area - then rapidly build up combat power before the enemy can concentrate his forces. They may have to push significant distances to achieve this, thereby stretching their logistics and engineering capabilities. Versatility then comes into play - Desert, Mountains, Tropic, Subtropic, Cold weather, Hot Weather - Nuclear - Chemical - Biological - all in a way are threats to the versatility of our forces - threats that we meet with a minimum of equipment and material variations, resulting in an effective logistical force.

There are five areas ~~(Figure 1)~~ in which we are making our major efforts. POL (Petroleum, Oils and Lubricants) concentrates on fuel delivery, storage and distribution with recent emphasis on support of mobile force operations. We are concerned with fuel flow from the offshore tanker to the fuel tank of the user vehicle ashore.

Logistic Mobility takes bullets, beans, and bandages along that same path, from Navy ships or Military Sealift Command container ships, roll-on, roll-off (RO-RO) or even barge ships across the beach to the ultimate user ashore. Our emphasis is on cargo/container handling and standardized packaging in both amphibious assault and Rapid Deployment Joint Task Force scenarios.

Horizontal Construction means improving our engineering efficiency by better planning and programming of earthwork and surfacing, and the reduction or streamlining of heavy equipment needs.

General Construction addresses expeditionary shelter technologies, with particular emphasis on mobility and effectiveness in climatic extremes.

Service and Support has, in the recent past, covered projects in a wide range of engineer facilities from laundry, shower and head units to solid waste disposal. Our present emphasis, however, is on combat engineer support to mobile forces for ammo and supplies, as well as concepts for fresh water supply, storage and distribution.

Our efforts in the POL PROGRAM area begin with the requirement to deliver one million gallons of fuel ashore per day to a notional MAF, a requirement which builds in a step fashion from the earliest days of the operation. Military Sealift Command (MSC) tankers up to 70,000 dwt (Figure 2) must be moored, and hoses or pipelines laid to effect this transfer. A large, single-point tanker moor (SPM) is necessary, like these used by oil companies in coastal areas of the United States and around the world (Figure 3). But our capability to quickly install one of these 150 ton monsters is nonexistent. Rather, we have developed a 57 ton SPM (Figure 4) that we can handle and install and that has the mooring capacity we need. We have developed the capability to string together and emplace up to 10,000 feet of 8" steel pipe from the beach to the SPM (Figure 5). Each pipeline can carry 800 gallons per minute of fuel and we plan on two pipelines, each capable of putting almost a million gallons of fuel ashore per day.

From the ship to the beach, the system is a Navy development. Marine Corps bulk fuel companies take over at the high water mark. The NCEL beach interface unit (Figure 6) accepts the Navy pipelines and distributes the fuel to the Marine 6 inch hose system. We are working on a powered hose reel (Figure 7) for cross-country hose laying and retrieval, as well as a new, lightweight, collapsible hose (Figure 8) with far fewer couplings and only about half the weight of the present hose.

A SIXCON (one sixth of an 8x8x20 ISO container in size) is an ISO compatible intermediate size container configured as a 900 gallon tank (Figure 9). SIXCONs were developed at NCEL several years ago and are ready for procurement by the Marine Corps. The six modules, when connected in the 8x8x20 overall configuration - five tank modules and a pump module - carry a total of 4,500 gallons (Figure 10). Individually, or coupled with a pump module, SIXCONs are helo-transportable and can be mobilized by a Marine Corps 10,000 pound rough terrain forklift (Figure 11). They can be used for water and other liquids as well. Our present push is for a small SIXCON mobilizer or trailer that could be towed by a tactical vehicle, thus extending their range. We call this the lizard tail concept, because the vehicle simply drops the trailer and SIXCON when empty, like some lizards can leave their tail behind when necessary.

As I said earlier, our second major area, LOGISTICS MOBILITY involves the throughput of bullets, beans, and bandages, also from the ship to the user. After the completion of a Marine Corps assault of a given beach, a fleet of MSC ships (Figure 12) will begin the offload of over 100,000 tons of supplies that constitute the Assault Follow-On Echelon. This works out to over 200 containers a day from the holds of these ships to the Marine Corps users ashore.

Cranes on board transfer vessels will begin the effort (Figure 13). A TACS (or auxiliary crane ship) will extract the containers and place them on lighterage (Figure 14). Our contribution to improved lighterage is the powered causeway section (Figure 15). This is an 8 knot, low gear tug made of Navy pontoons and powered by a pair of water jet thrusters with a 360° sweep. It can push a long string of

unpowered causeways loaded with containers (Figures 16 and 17), or act as a workboat emplacing fuel or other nearshore systems. Four of these powered causeway sections can be carried to the operation sideloaded on each LST (Figures 18 and 19). These have been approved for service use and are in procurement.

At the beach, the surfzone can be bridged by other pontoon causeway sections elevated on pipe piles and equipped with a crane to transfer containers from lighterage to trucks (Figure 20). An air bearing system (Figure 21) allows trucks to do the 180° turn necessary at the pier head. The containers are loaded on trucks and start the short trip to the beach support area (Figure 22).

As a backup to the elevated causeway for surfzone throughput of containers, the Marine Corps has electd to develop the Lightweight Amphibious Container Handler (LACH) (Figure 23). The LACH is a simple, inexpensive straddlelift device which can go aboard a beached lighter and retrieve a container, return to shore and lift the container aboard a logistic trailer. The LACH has flotation tires for work on soft sandy beaches and can negotiate up to five feet of water as it wades from beach to lighter (Figure 24). There is considerable Army interest in the LACH, with some consideration given to extending its capability to handle containers up to 40 feet in length.

To the military, containerization means 8x8x20 ISO containers (granted that 40-footers are becoming prevalent, but until now we are concentrating on handling 20-footers). But we feel we also need intermediate containerization. This means modular containers that are smaller than the 8x8x20, which can be lifted and moved easily at the company or battalion level, for example, but which can be connected together in an 8x8x20 shape to fit aboard a container ship for transport. At their destination, they are offloaded as an 8x8x20 with the resultant efficiency of a container-sized lift, but, once ashore, they separate again into their smaller, modular configurations to allow easier handling by the military logistic system. Almost every fractional size of intermediate container has been developed at one time or another.

For example, HALFCONs and TRICONs exist. Earlier in this presentation I showed the NCEL-developed SIXCON. Two of our other develoments have been the QUADCON and PALCON. The QUADCON (Figure 25) is, of course, one-quarter the size of an 8x8x20 and can be outfitted with racks holding thirty-six composite, covered field boxes (inserts), each of which is compartmented and capable of holding up to 140 pounds of equipment, spare parts, etc. (Figure 26). Maximum gross weight of each QUADCON will be 10,000 pounds, to be handled by a 10,000 pound rough terrain forklift.

The PALCON (Figure 27) is an enclosed, pallet-sized container with lockable doors and a maximum gross weight of 2,000 pounds. Interior racks can be added to the PALCON to enable it to carry six field boxes (inserts). PALCONs are of relatively light construction for maximum payload, and are not intended to lock together into an 8x8x20 shape. They can, however, be interconnected in a 2x2x2 array (Figure 28) with a maximum gross weight of 10,000 pounds for handling by the 10K rough terrain forklift.

In the HORIZONTAL CONSTRUCTION area, major emphasis has been in development of computer-aided techniques for planning and construction management of earthwork in expeditionary construction; and in development of techniques for Rapid Runway

Repair (RRR) and Bomb Damage Repair (BDR). The computer project, entitled AOA Development Engineering (Figure 29), utilizes realtime reconnaissance and intelligence data to produce maps containing accurate topography and other necessary soil and engineering data. The program can then position critical facilities within the mapped area, compute earthwork and equipment efforts, and produce time and equipment schedules (Figure 30). The system has the capability to adjust the position, orientation, and elevation of the facilities with the goal of minimizing the overall personnel, equipment and construction times required.

Runway repair efforts have been closely coordinated with the Air Force RRR Program and have involved development of bomb crater backfill designs and design and testing of Fiberglass Reinforced Polyster (FRP) covers for craters, replacing the previously-used aluminum matting (Figures 31 and 32).

GENERAL CONSTRUCTION projects have focused on the development of new, lightweight and inexpensive expeditionary shelters for all weather use. Both the Navy and Marine Corps have evidenced their need for a family of shelters, up to aircraft size, that are very quickly erected, and which can be struck and re-erected as often and as easily as a tent (Figure 33). Tensioned membrane structures are a fairly new item and are obvious candidates. Using new high-strength reinforced fabrics, these buildings are simply large arch-like structures with rigid ribs (Figure 34). They are covered with the heavy membrane fabric which is tensioned between ribs, forming a strong, but lightweight structure. Some structures are offered in widths up to 120 feet and heights of 60 feet, large enough to accept many types of aircraft. With erection times measured in hours, not days, these structures offer a true expeditionary capability, essentially doubling or tripling the construction productivity of the engineer forces involved.

In the Service and Support area, our major effort is in effecting improvements to the Army-developed Reverse Osmosis Water Purification Unit for procurement by the Marine Corps and the Navy (Figure 35). Army advances in membrane technology have made the reverse osmosis process feasible for field use in water treatment. More efficient and more cost-effective than any other state-of-the-art water treatment system, the Army ROWPU can produce up to 600 gallons per hour of potable water from seawater or brackish water sources. NCEL efforts will be to improve pretreatment and filter efficiencies, to lighten the weight of the unit, and to increase its capacity (Figure 36).

The projects I've just described have been the high points of our Amphibious/Advanced Base Program here at NCEL. Many other projects are under way which I have not had the time to present. My office is always available to discuss these efforts if you would care to get in touch with us.

Logistics and expeditionary engineering problems are by no means solved. This is a field unique to military needs, and a modern, smooth-flowing logistics system can be the winning edge for a military force far from home.

Problems remain - For example, firefighting, ammo containerization, container marshalling, handling and storage; and even the development of facilities to allow people to live and work in chemical, biological or radiological contamination.

The Marine Corps must stay light to remain mobile, but they face a mounting need for logistic tonnage to support their increasing firepower and offensive capability. Seabees must maintain their "can do" reputation. We at NCEL, with your help, will do our best to see that these things happen.

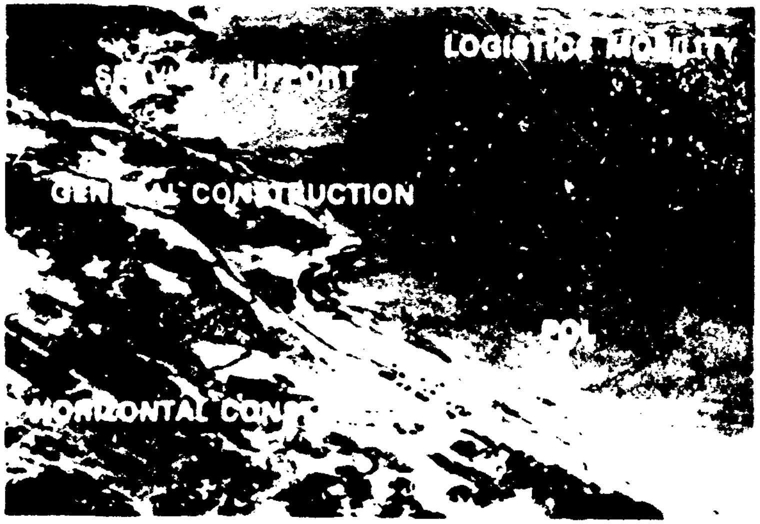


Figure 1. Amphibious/Advanced Base Program.

Figure 2. Large MSC tanker.

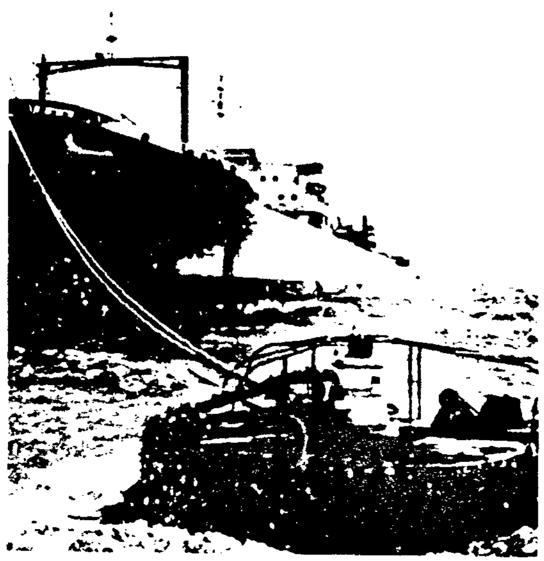


Figure 3. Conventional single point moor.

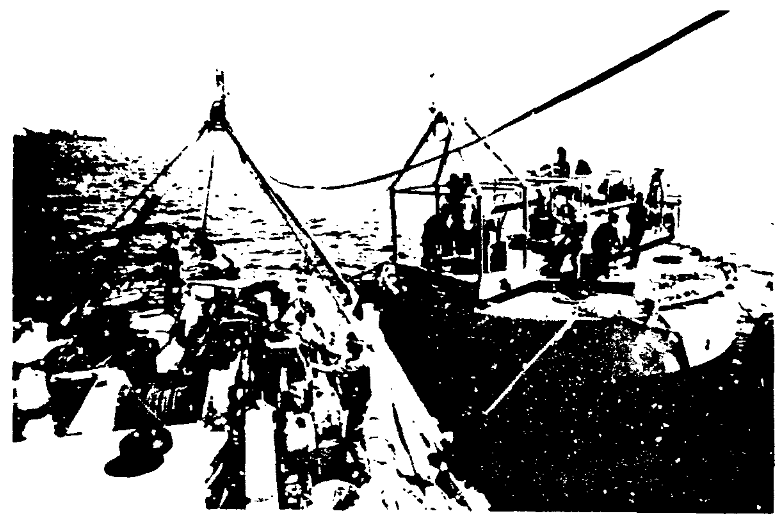


Figure 4. NCEL lightweight single point moor.

Figure 5. Ship to shore pipeline.

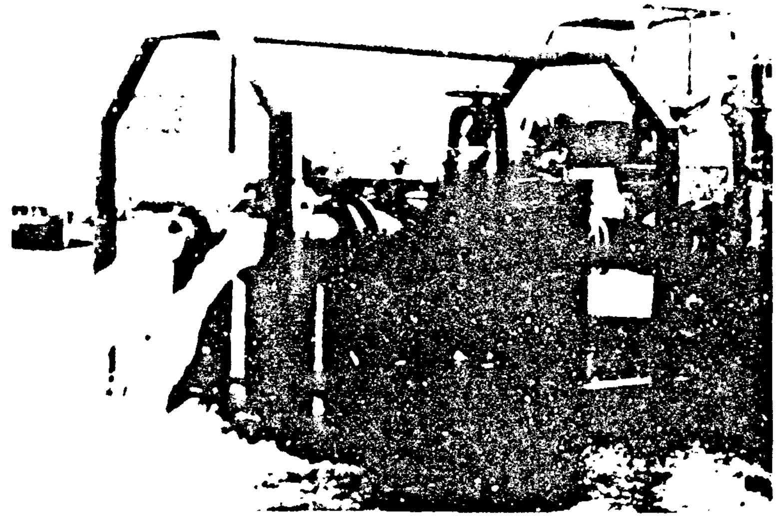


Figure 6. Beach interface unit.

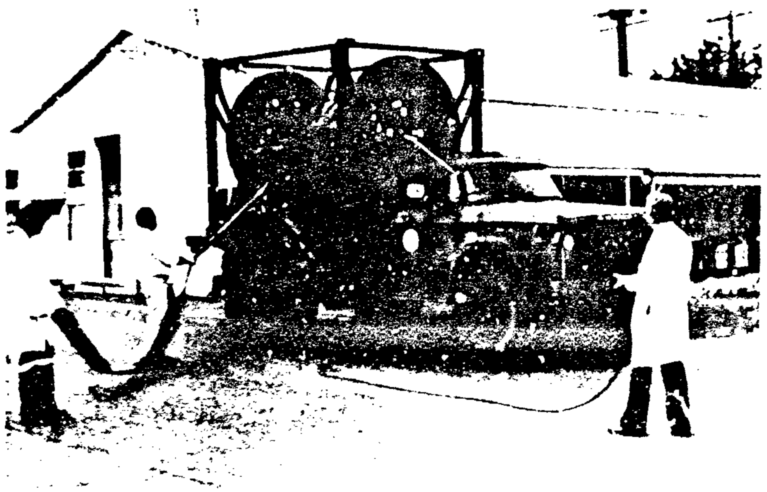


Figure 7. Shoreside POL hose reel (prototype).

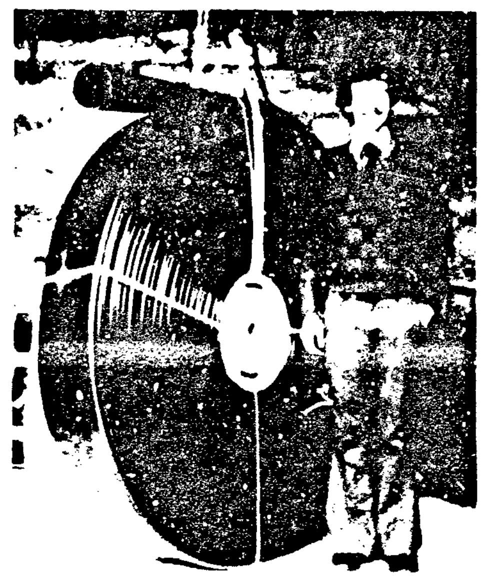


Figure 8. Lightweight collapsable hose.

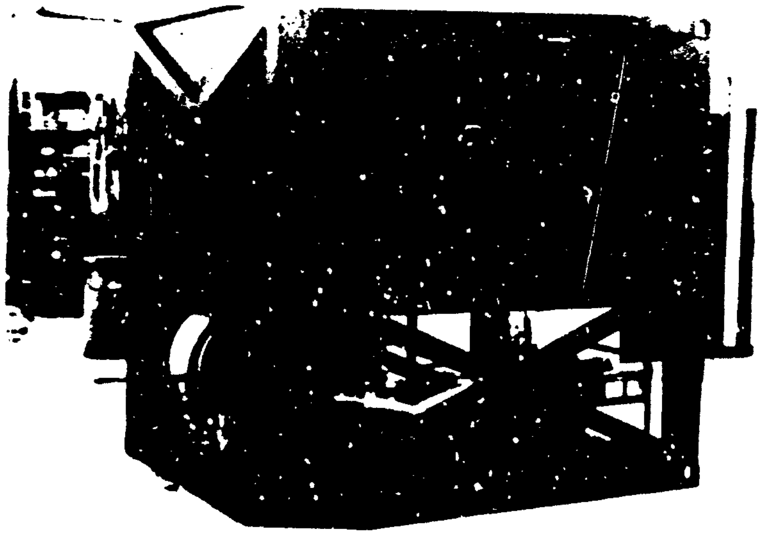


Figure 9. Sixcon tank and pump modules.

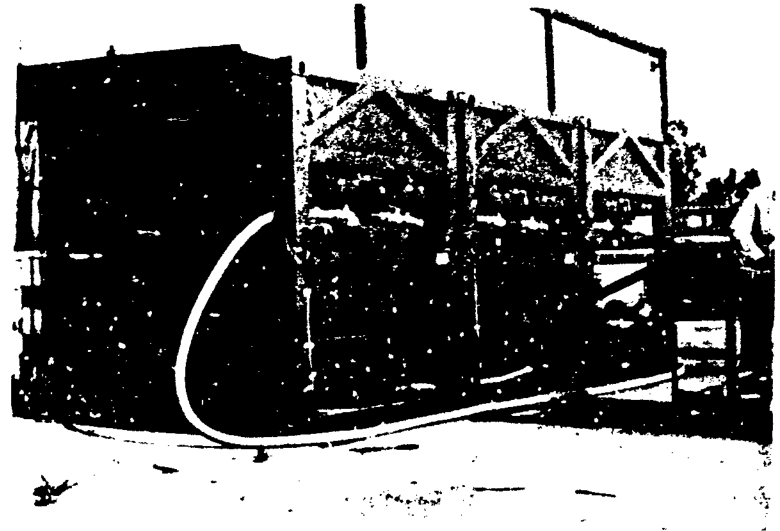


Figure 10. Sixcons in 8 x 8 x 20 configuration.

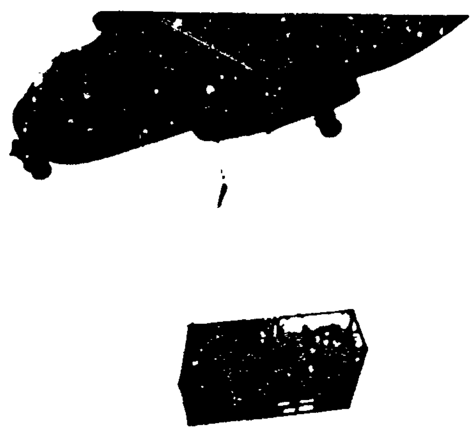


Figure 11. Helicopter lift of Sixcons.

Figure 12. Container ship.

Figure 13. TACS type container offload.

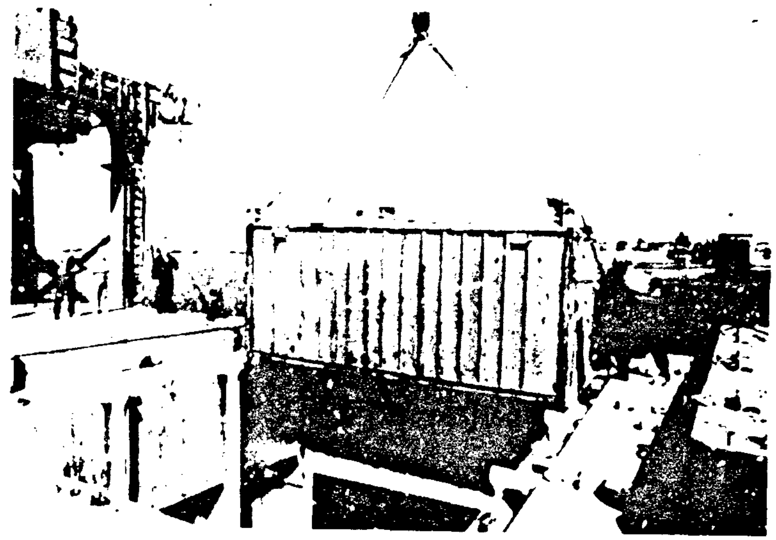


Figure 14. Container lift.

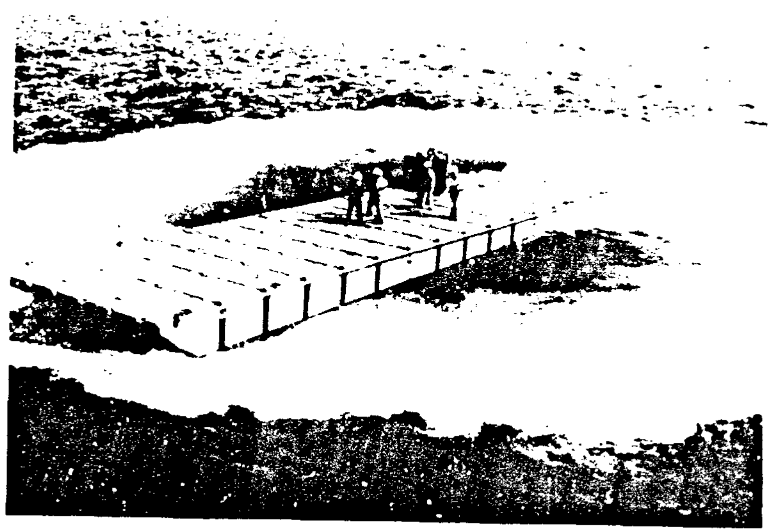


Figure 15. Powered Causeway Section (PCS).

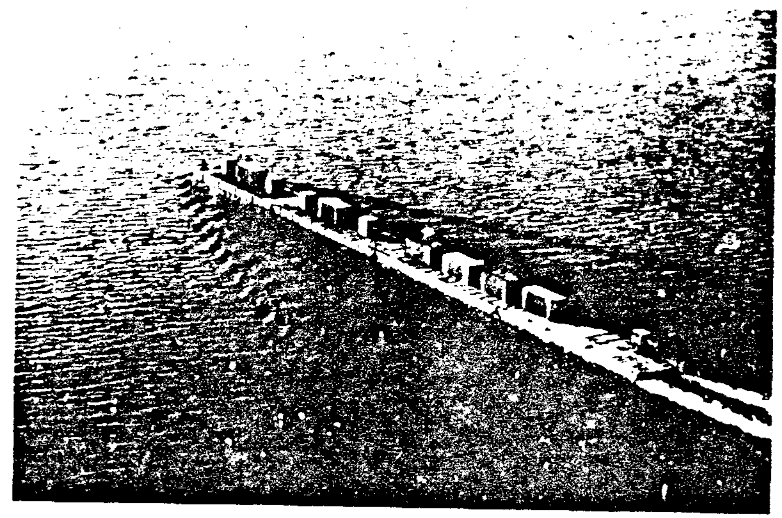


Figure 16. PCS/causeway ferry operation.

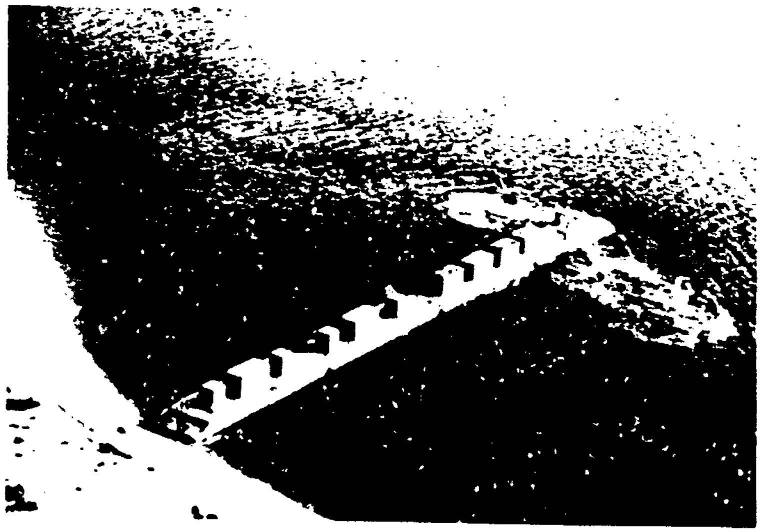


Figure 17. PCS/causeway ferry operation.

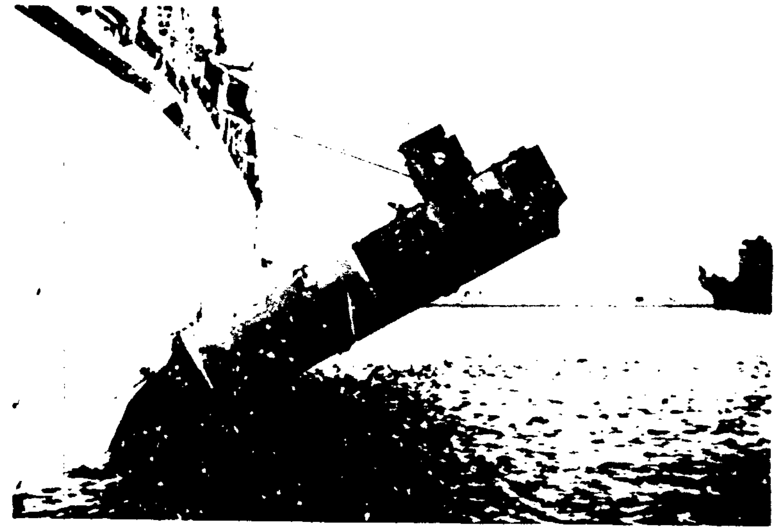


Figure 18. PCS sideloading on LST.

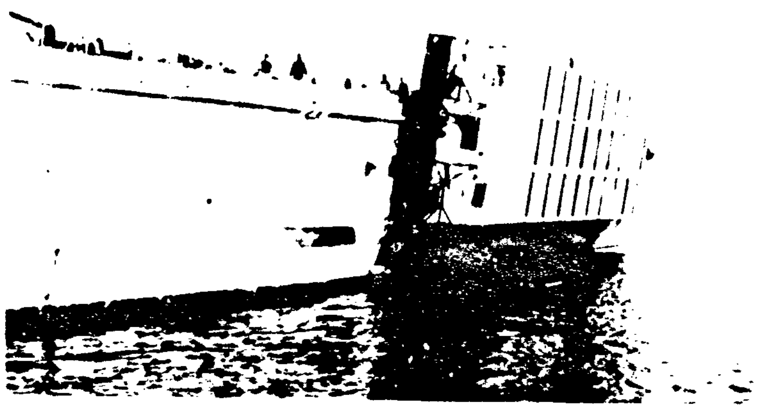


Figure 19. PCS sideloading on LST.

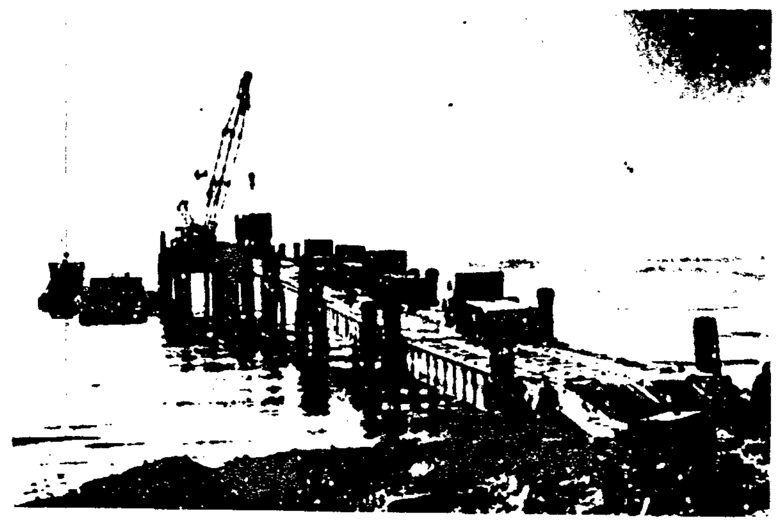


Figure 20. Elevated causeway (ELCAS).

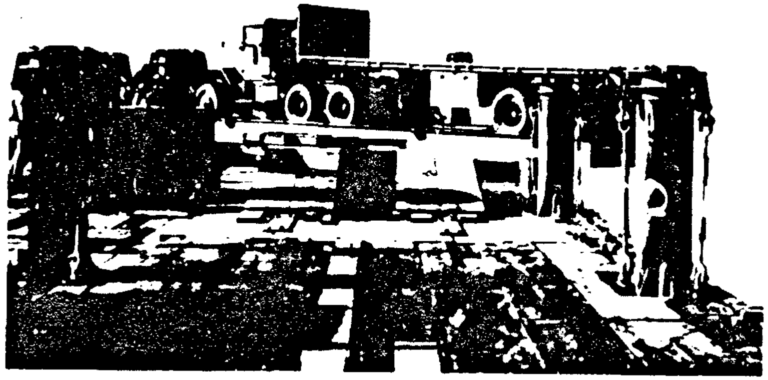


Figure 21. Truck turntable on ELCAS.

Figure 22. Container transfer on ELCAS.

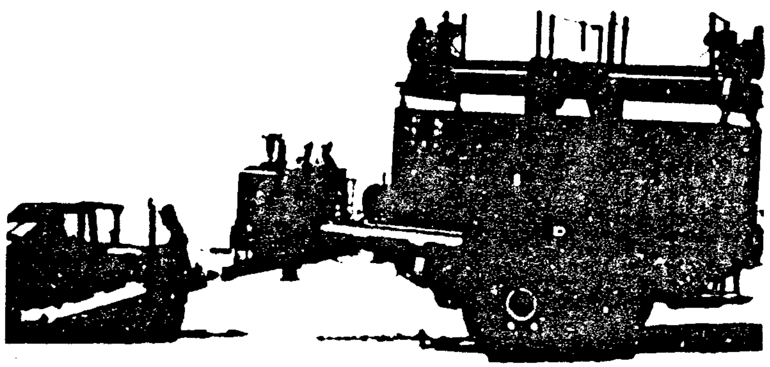


Figure 23. Lightweight Amphibious Container Handler (LACH).

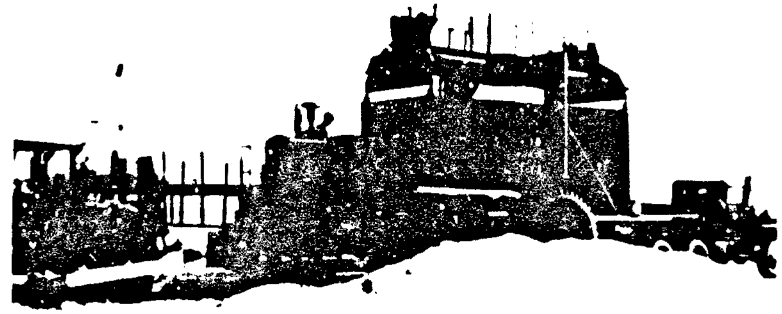


Figure 24. LACH operations.

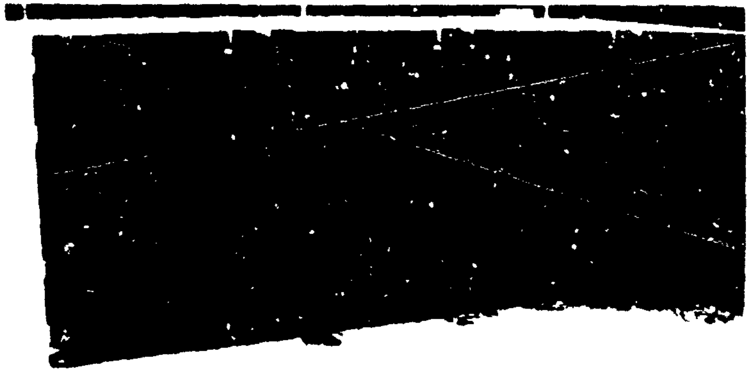


Figure 25. Quadruple Container (QUADCON).

Figure 26. Quadruple Container (QUADCON).

Figure 27. Pallet Container (PALCON).

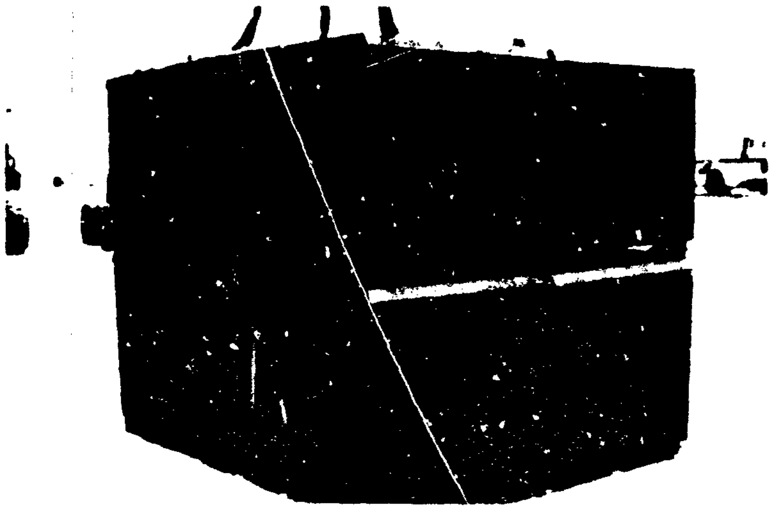


Figure 28. Pallet Container (PALCON).

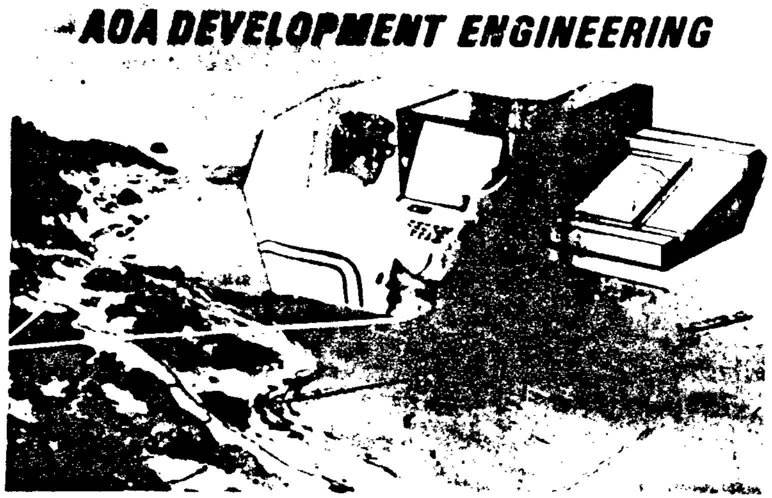


Figure 29. Automated AOA Development Engineering.

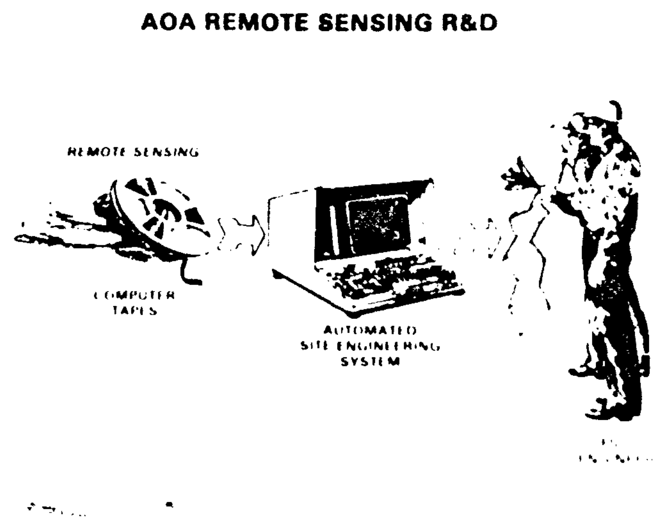


Figure 30. Automated AOA Development Engineering.

Figure 31. Rapid bomb damage repair tests.

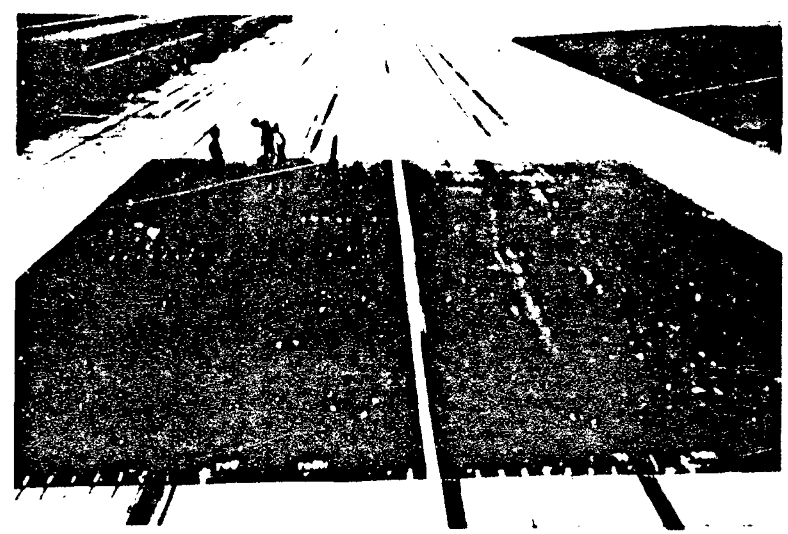


Figure 32. Rapid bomb damage repair tests.

Figure 33. 40' x 80' Tensioned Membrane Shelter (TMS).

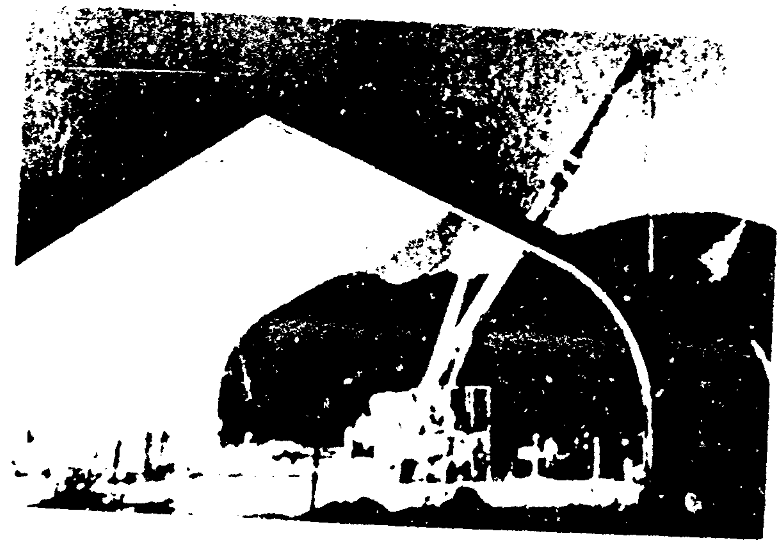


Figure 34. 90' wide TMS for helo hangar

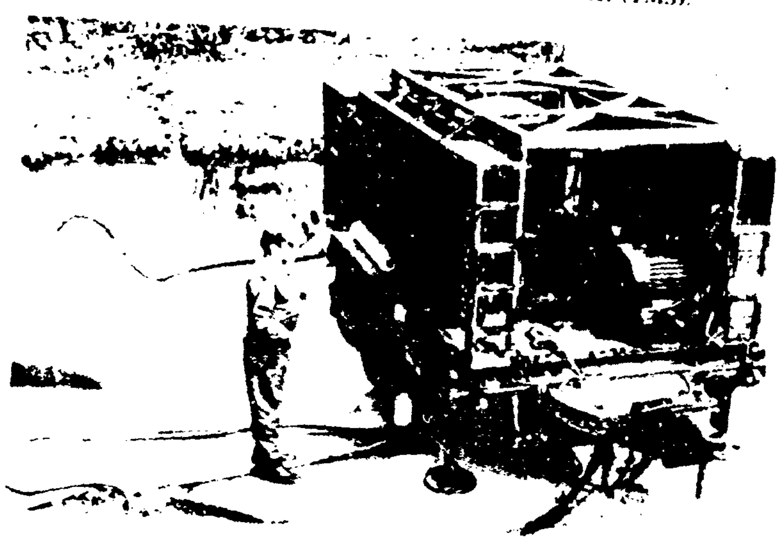


Figure 35. Reverse OSMOSIS Water Purification Unit (ROWPU).

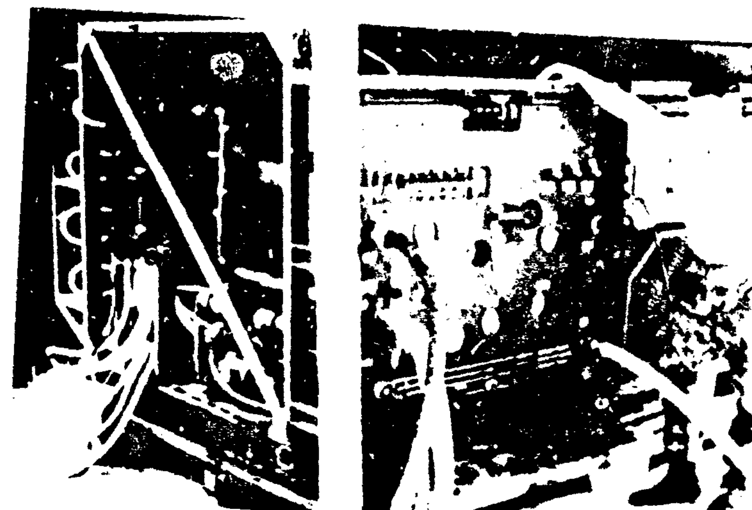


Figure 36. Reverse OSMOSIS Water Purification Unit (ROWPU).

THE EFFORTS OF THE FMC ORDNANCE DIVISION TO INTEGRATE PH&T INTO THE OVERALL ILS PLANNING EFFORT

by

STEPHEN FURTADO AND WILLIAM MORGAN
FMC ORDNANCE DIVISION
LOGISTICS SUPPORT
SAN JOSE, CALIFORNIA

FMC integrated its logistics support functional groups (Figure 1) over five years ago in order to further expand its product line support as well as decrease life cycle costs for its customers. FMC's Logistics Support Department (Figure 2) provides the full range of integrated logistics support including logistics support analysis; manpower, personnel, and training development; technical publications; field service support as well as packaging, handling, and transportation (PHT) engineering. The PHT Engineering Group (Figure 3) is responsible for packaging, handling, and transportability analysis of engineering design and product development and development of packaging, shipping and transport documentation and products to support delivery and field support of FMC defense equipment.

With the fielding of the Bradley Fighting Vehicle System FMC Ordnance Division is turning its skills to meeting future defense equipment needs. Through participation in a number of Army and Navy advanced development studies, Logistics Support has had the opportunity to integrate PH&T analysis as part of the overall logistics support analysis. In the Division Support Weapon System (DSWS) studies (Figure 4) PH&T analysts have assessed critical logistics issues and developed PH&T concepts to meet these issues. This effort has integrated PHT analysis into FMC's overall DSWS ILS planning and concepts.

The Division Support Weapon System studies defined needs and requirements for a future technology 155mm self-propelled howitzer for the Army Field Artillery. In the first DSWS study there were eleven critical issues to be resolved. The major issue affecting ILS was ammunition resupply for an automated, highly-

mobile howitzer system. Specifically the PHT analysis of the ammunition resupply critical issue had to analyze and determine the sufficiency of existing Army ammunition resupply structures against DSWS firing unit requirements, then develop an ammunition resupply concept to address shortfalls, allow flexibility to the Force Commander, meet the Nth day of battle requirements, and minimize the overall support system burden.

The analysis considered a number of ammunition resupply studies and simulation models including studies by DARCOM, TRADOC Combined Arms Test Activity, U. S. Army Missile and Munitions Center, ARRADCOM, and U.S. Army Human Engineering Laboratory. Threat analysis (Figure 5) conducted by FMC operations analysis group and subcontractors projected the 1990's threat which DSWS would have to meet. For the 1990 threat it was estimated the DSWS Battalion would require over 450 rounds per tube (cannon) per day. Based on the 1990's threat and current ammunition resupply system statistics it was clear that the DSWS requirements alone would exceed the capacity of the current Brigade ammunition transfer point. DSWS requirements in conjunction with planned or development automated armor, infantry, and air defense systems would impose a critically adverse impact on the ammunition resupply system as a whole. Based on the threat estimates, the ILS analysis then centered on the capacity of the ammunition support structure to support the required DSWS firing rate.

The DSWS requirement of 450 rounds per cannon per day translates to a 270 short ton demand for each DSWS firing unit (or battery). This equals 810 short tons for each DSWS Battalion. The present division ammunition resupply system can only provide a maximum of 635 short tons per day (Figure 6). For an armored division, 75% of the division's ammunition support is for 155mm and 8-inch artillery ammunition. Firing rates (Figure 7) compiled by the Field Artillery School clearly show that a single 155mm howitzer battalion will require more than one-third of the armored division estimate. Clearly, the ILS analysis showed that DSWS would require changes to the current ammunition support structure.

Since ammunition resupply requires delivery of clean, reliable munitions to the firing unit, it is most dependent on packaging, storing, handling, and transportation techniques. When the threat analysis revealed that the current system would face severe impact from the DSWS requirement, it became clear that the ammunition resupply study would require PHT analysis and concept development expertise.

The PHT analysis investigated the current ammunition resupply structure as well as planned changes for Division 86 to determine significant shortfalls in packaging, handling, and transportation of ammunition. The basic ammunition resupply system (Figure 9) involves packaging of ammunition in MILVAN containers at the plant or load, assembly, pack (LAP) point, transport to the theater port facility, and then to either the Corps Storage Area or the Division Ammunition Supply Point (ASP). At the ASP ammunition containers are broken down, sorted and loaded onto unit resupply vehicles, either 5-ton trucks or 8-ton GOER vehicles. Division 86 planning calls for supplement of the ASP with an ammunition transfer point (ATP) in each divisional brigade area to handle high usage items. Division 86 planning for the ATP also includes use of material handling equipment to take advantage of MILVAN containerization. With these assets the ATP is expected to handle up to 500 short tons per day.

As a result of the threat analysis and the ammunition resupply system analysis, it was determined that DSWS ammunition resupply requirements would exceed the capability of the brigade ATP. The PHT analysis of the system revealed shortfalls (Figure 10) in these areas:

- The quantity and capabilities of the transportation equipment in the resupply chain were inadequate.
- The quantity and capabilities of the material handling equipment were inadequate for smooth and efficient transfer to DSWS resupply vehicles.
- The capacity of the ATP was dependent on the location and efficient operation of the ASP and CSA. In those areas present ammunition packaging and lack of inherent handling provisions resulted in inefficiencies and degraded throughput to the ATP.

Thus, FMC's ILS concept for ammunition resupply needed to answer shortcomings in packaging, handling, and transportation of ammunition as well as not impose additional burden on the Army's logistic system.

The answer to this concept came to focus on ammunition packaging and handling. (Figure 11). This was driven not only by the high rate of fire but also the fact that DSWS was capable of firing 442 combinations of fuze, projectile, and propellant. In addition to this, the philosophy for DSWS was to have an highly mobile howitzer which could "shoot-and-scoot" to avoid enemy detection and counterfire. It was therefore logical that DSWS would require protected ammunition

resupply vehicles with inherent material handling equipment. Whether this MHE requirement should be met on the unit's ammunition resupply vehicles or with a dedicated caisson for each howitzer became a subject for trade-off.

The ammunition packaging concept was critical, also. DSWS had a requirement to use not only the specially packaged new DSWS ammunition, but also the existing ammunition stocks in the current system packaging configuration. In addition to this, the packaging had to be accommodated to MILVAN containerization and transport and current material handling equipment transfer in order to not adversely impact the current system burden. Furthermore, the packaging had to reduce the burden on the user to unpackage the munition and dispose of debris. The PHT analysis identified and selected pacing technologies which would accomplish these requirements.

The FMC DSWS concept was to use current and planned transportation assets, (Figure 12) such as the MILVAN and 10-ton HEMTT for transporting packaged ammunition to the ATP. The DSWS concept included dedicated Artillery Armored Resupply Vehicles (ARV) (Figure 13) from the ATP to the cannons and an armored caisson to accompany the howitzer. Material handling equipment would include current and planned assets such as rough terrain forklifts and cranes in the ATP. (Figure 14). And, FMC's ILS team recommended establishment of a dedicated DSWS ATP (Figure 15) to meet the Brigade DSWS battalions common requirements and reduce impact on the Division's ATP(s). The FMC-proposed DSWS ATP would be capable of handling 1000 short tons per day using the current and planned ATP Mat ial Handling Equipment.

The centerpiece of the FMC concept was a modularized ammunition packaging concept (Figure 16). The ammunition module was to provide protection, inherent material handling capability, and be compatible with advanced administration and control techniques such as LOGMARS and SAAS-4 systems. Also, the PAM as we began to call it would meet the weight and cube requirements of MILVAN and HEMTT transportation assets as well as the DSWS ARV and caisson. The FMC concept called for existing ammunition stocks to be upgraded into PAM(s) during routine ammunition renovation checks or at the CSA using equipment designed for this purpose. The packaging would accommodate transfer to the ARV using forklifts and from the ARV to each cannon's caisson using a rough-terrain crane incorporated into the caisson's design.

This DSWS ammunition resupply concept and ATP organization was then applied to eight LOGATAK II simulation runs to determine the ability of the proposed system and transportation to support the required rates of fire (Figure 17). The overall results indicated that the concept did meet the requirements and accomplished

the following reductions in ammunition resupply logistics burden:

- Reduced Division CS ammunition train by 12 10-ton trucks;
- Eliminated unprotected ammunition trucks and personnel in firing units;
- Reduced the Brigade ATP burden by 810 short tons per day; and
- Met the operational ammunition supply rates to the "Nth" day of battle.

With the submittal and Government review of FMC's Phase I Report, further study of the ammunition resupply concept was necessitated. The Government asked for FMC to take another look at ammunition throughput to confirm transportation and material handling equipment requirements. In addition, FMC was asked to undertake further analysis and design trade-offs of the protected ammunition module concept.

This "second-look" (Figure 18) incorporated an ammunition throughput timeline study which resulted in refinement of the FMC concept. This Handling and Transportation analysis revealed that an additional 10-ton truck was needed to accommodate ATP requirements and that the caisson with inherent material handling equipment was not efficient. Instead, the study determined that the crane was better utilized on the ARV and that the caisson was better utilized as an element of the battery storage area in order to meet surge rate demands in the later days of the engagement.

The ammunition packaging study (Figure 19) involved conduct of tradeoffs on type of modularization, packaging materials, and packaging methods. The results of this analysis revealed that the preferred concept (Figure 20) was an ammunition magazine module consisting of individual laminated composite tubes packed into a "six-pack" carrier of molded polymer plastic with inherent material handling equipment capability. This concept met the goals and constraints for containerization, handling, transportability and preservation as well as demonstrated life cycle costs comparable to current pallet costs. Though this analysis was accomplished prior to recent HEL studies and the BRASS 2000 studies, it appears compatible to Unit Configured Load (UCL) concepts as well as robotic handling techniques. The major analysis consideration now is determining the most efficient point of breakdown for the ammunition module. Analysis along these lines is currently being undertaken by HEL and the BRASS 2000 group and will add significantly to maximizing an ammunition resupply concept for DSWS.

Conferences such as this are enabling FMC to advance its knowledge of ammunition resupply techniques to further advance our concepts for DSWS and other programs.

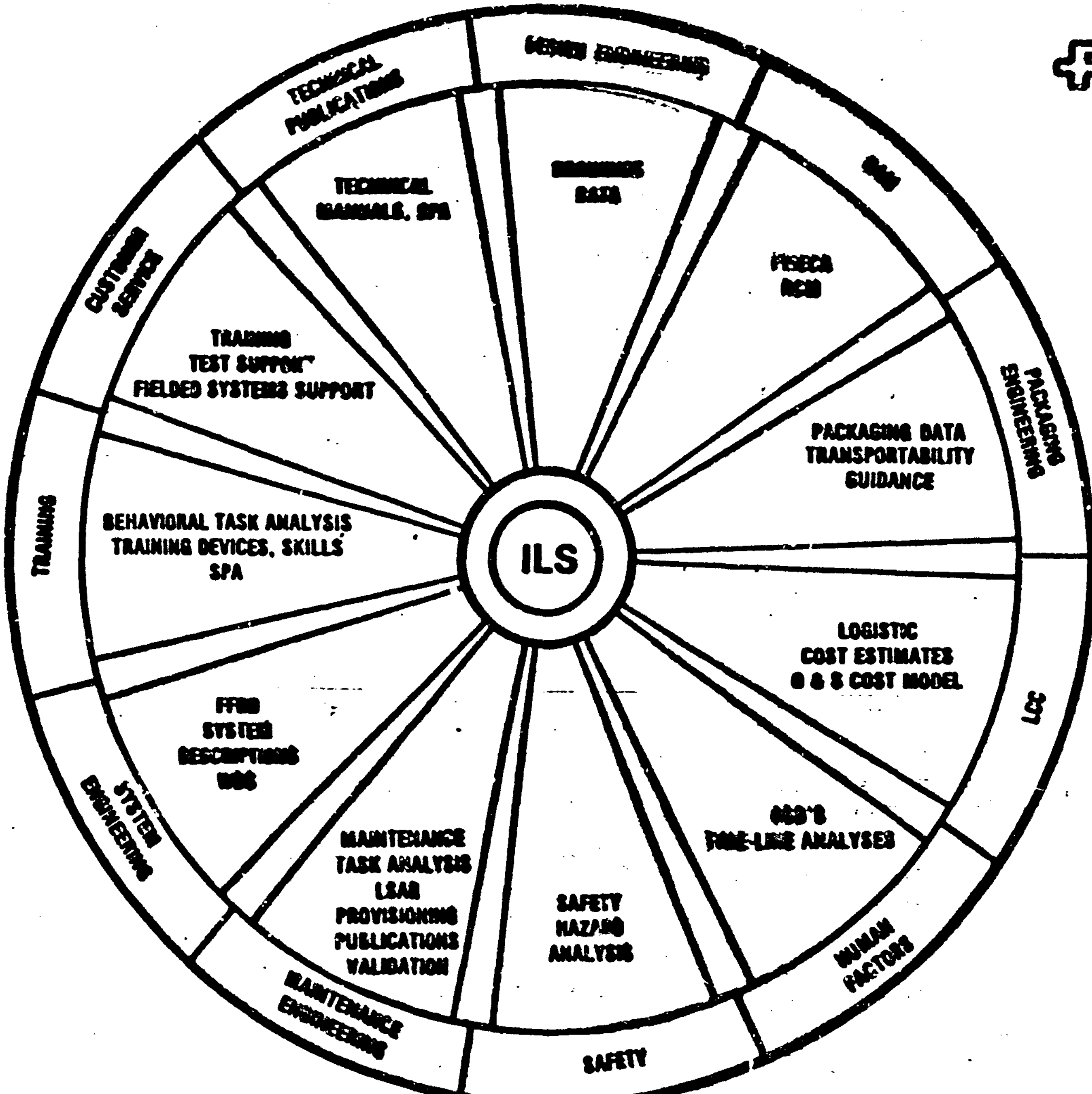
In conclusion, (Figure 21.) the DSWS program has afforded FMC a focal point for development and integration of our PHT analysis capability into overall ILS concepts. Development of this capability has been furthered at FMC through other study programs such as the Future Close Combat Vehicle System Study and the Mobile Protected Weapon and Gun System Studies. Currently, PH&T analysis is playing a significant role in our LVT-X Study and preparation for the potential DSWS Demonstration and Validation Phase Contract.

The development of complex and sophisticated combat vehicle systems by the Army and Navy has increased the need for innovative PH&T concepts and planning. From the Bradley Fighting Vehicle Systems program through the DSWS Studies FMC has built its PH&T capabilities as part of a dedicated integrated logistics support for its product lines.

THE EFFORTS OF THE FMC ORDNANCE DIVISION TO INTEGRATE P, H, AND T INTO THE OVERALL ILS PLANNING EFFORT

Stephen Furtado
and
William Morgan

Ordnance Division
Integrated Logistics Support
FMC Corporation
San Jose, CA


ILS
TECHNICAL PUBLICATIONS
TECHNICAL MANUALS, SPA
CUSTOMER SERVICE
TRAINING
TEST SUPPORT
FIELDED SYSTEMS SUPPORT
TRAINING
BEHAVIORAL TASK ANALYSIS
TRAINING DEVICES, SKILLS
SPA
SYSTEM ENGINEERING
FFBD
SYSTEM
DESCRIPTIONS
WBS
MAINTENANCE ENGINEERING
MAINTENANCE
TASK ANALYSIS
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PUBLICATIONS
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SAFETY
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HAZARD
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HUMAN FACTORS
TIME-LINE ANALYSES
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O & S COST MODEL
PACKAGING ENGINEERING
PACKAGING DATA
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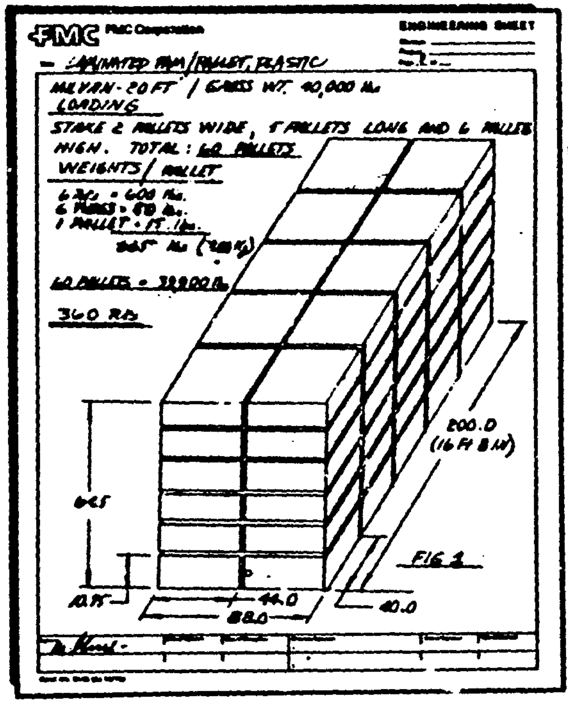
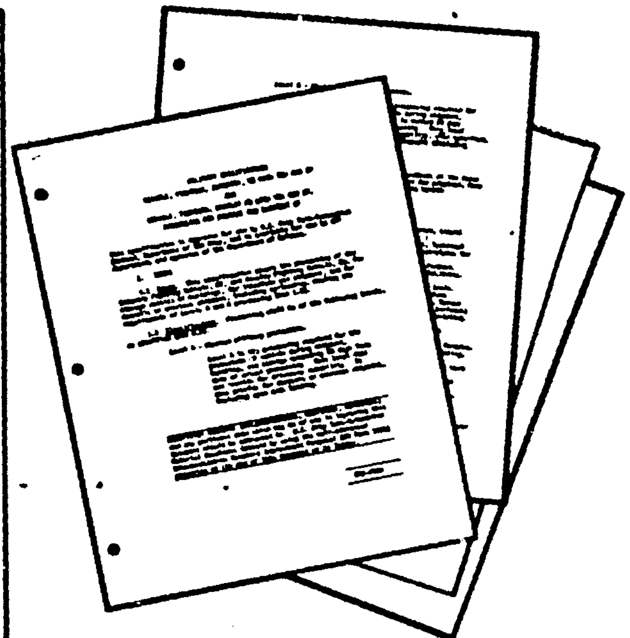
GUIDANCE
FMECA
RCM
DESIGN ENGINEERING
DATA

PH and T Engineering Provides . . .

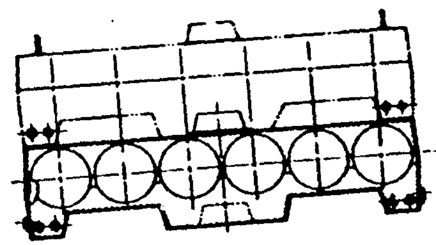
Analysis



Documentation



Products



DSWS Studies Integrated PH and T Analysis into Overall ILS Concepts

FMC

- Future Technology — 155 mm Self-Propelled Howitzer
- Major ILS issue of ammunition resupply
- PH and T analysis and concepts to meet requirements and minimize burden

Threat Analysis Determined Ammunition Requirement

FMC

- 450 rounds/tube/day
- 270 short tons/battery
- 810 short tons/battalion

Present Ammunition Requirement Shows Artillery Ammunition Using 75% of Division's Support

FMC

AMMUNITION RESUPPLY REQUIREMENTS BY UNIT
D-DAY THRU D +15 (COMPILED IN 1977)

	SHORT TONS PER DAY		
	DISTRIBUTION	COMMITTED	SURGE
UNIT	RATE	RATE	RATE
TANK BN, M60A1/3	39	54	202
TANK BN, M60A2	22	37	265
MECH. INF. BN (M113)	19	31	87
ATK HEL CO	7	36	106
AIR CAV TROOP	3	16	47
HOWITZER BN, 155 MM (SP) (M109A1)	309	407	635
HOWITZER BN, 8" (SP)	183	244	613

Firing Rates Show 155 mm Battalion Requires 1/3 of Division Total

FMC

TYPE BN	AVERAGE	SURGE	PEAK
C-SERIES			
155 MM — 3 x 8	600	912	1104
8-INCH — 3 x 4	360	528	672
8-INCH — 3 x 6	540	792	1008
8-INCH — 3 x 4, MLRS — 1 x 9	756	1122	1500
MLRS — 2 x 9	792	1188	1656
DIVISION TOTAL	4248	6366	8148
CANNON TOTAL	3063	4588	5666
MLRS TOTAL	1185	1778	2482
S-SERIES			
155 MM — 3 x 8	600	912	1104
8-INCH — 3 x 4	360	528	672
8-INCH — 3 x 6	540	792	1008
8-INCH — 2 x 8; MLRS 1 x 9	876	1298	1724
MLRS — 3 x 9	1188	1782	2484
DIVISION TOTAL	4764	7136	9200
CANNON TOTAL	3183	4764	5890
MLRS TOTAL	1581	2372	3310

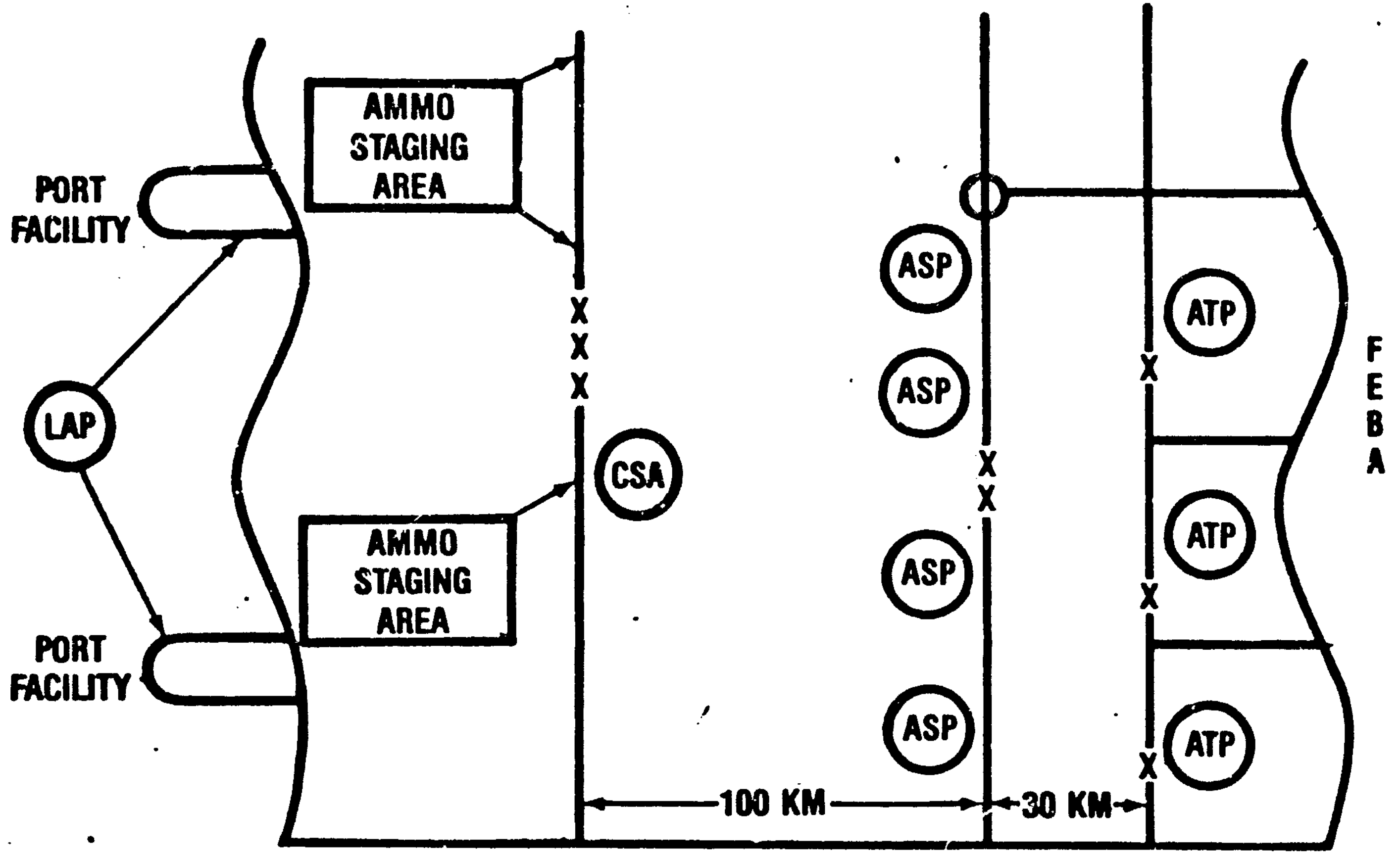
PH and T Analysis Required to Address DSWS Impact on Ammunition Resupply

FMC

- Determine PH and T shortfalls
- Develop concepts to answer shortfalls
- Develop technologies to accomplish concepts

Conventional Ammunition Resupply System

FMC



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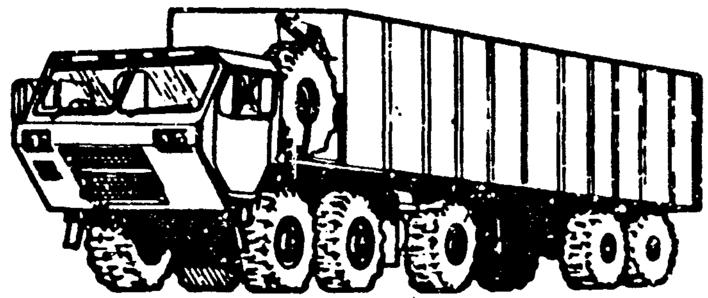
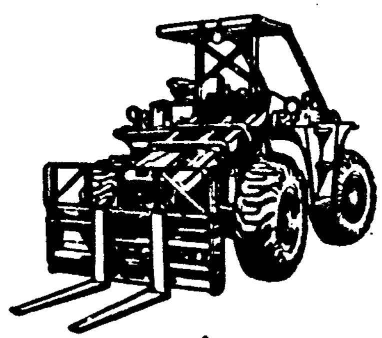
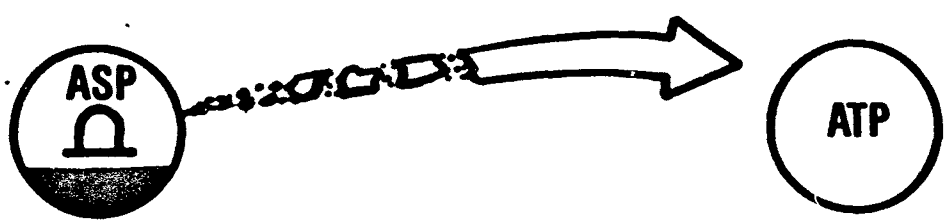
PHT Analysis Revealed System Shortfalls





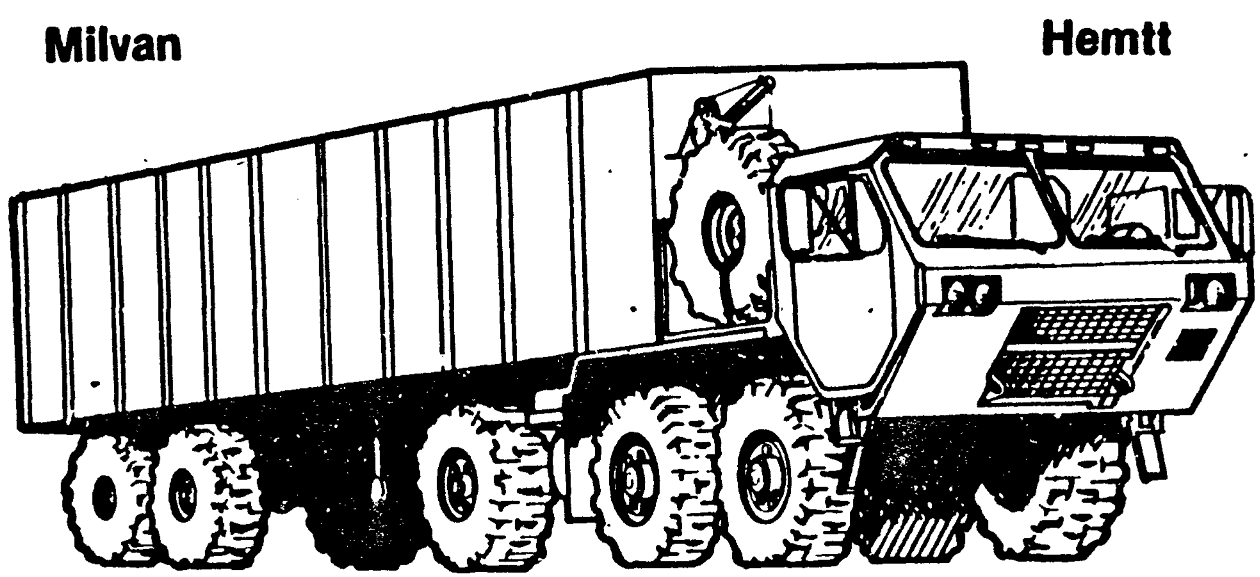


PHT Concept Focused on Ammunition Packaging and Handling

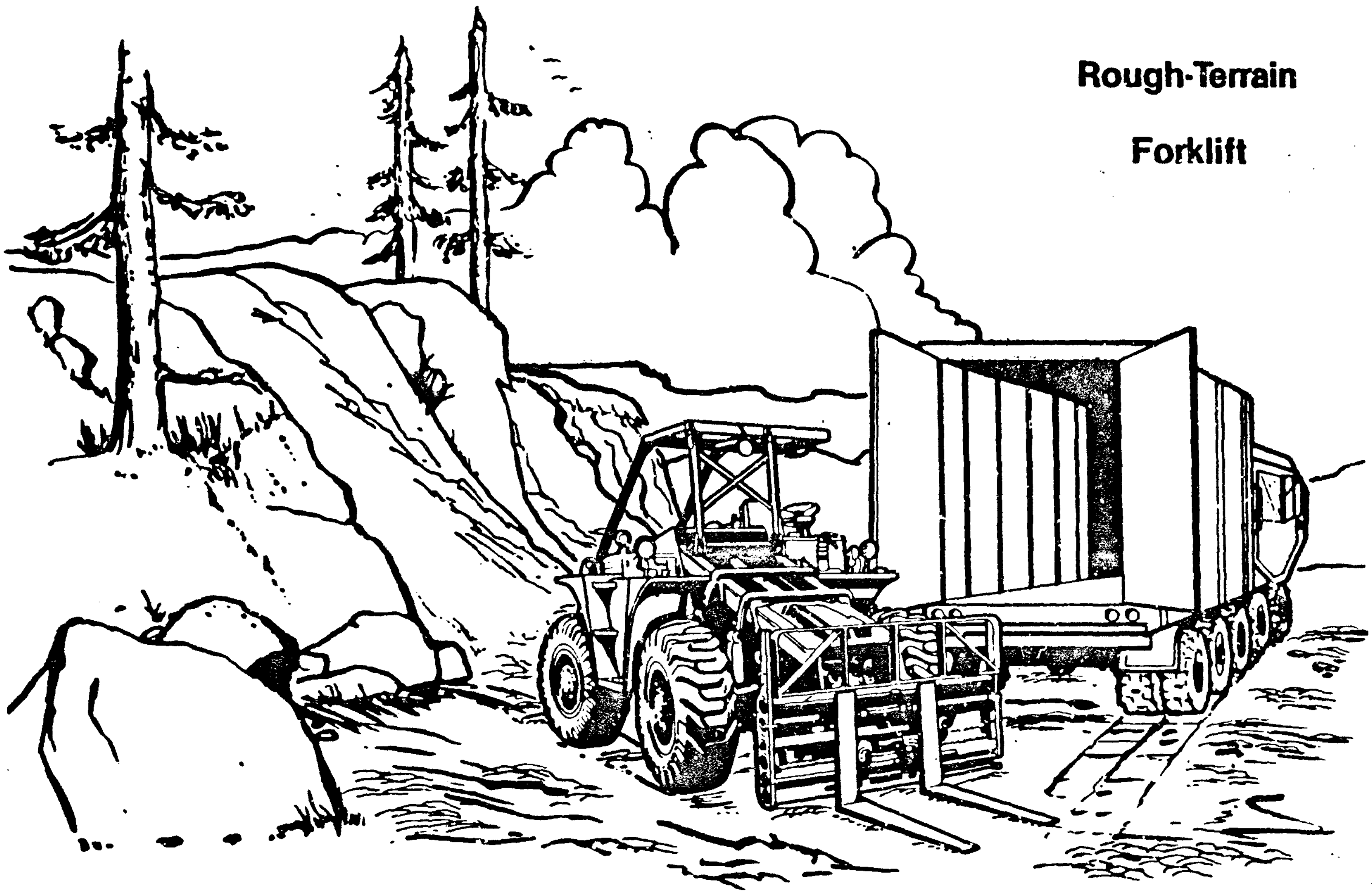
FMC

- Inherent MHE characteristics
- Integrate old and new ammunition stocks
- Adaptable to Milvan and MHE currently in system

PHT Concept Uses Current and Planned Transportation Assets



Rough-Terrain Forklift



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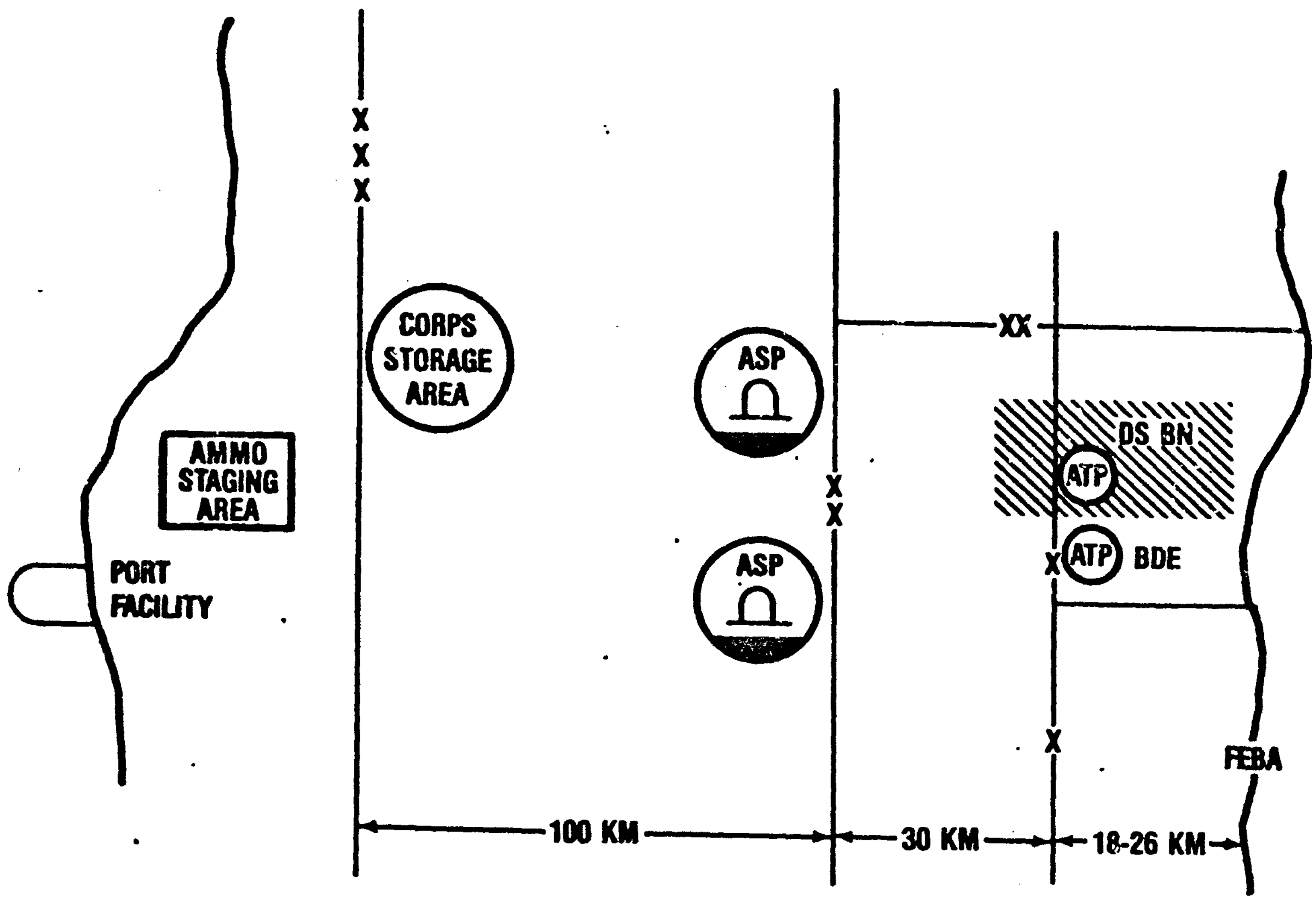
FMC Proposed a Dedicated DSWS ATP

FMC



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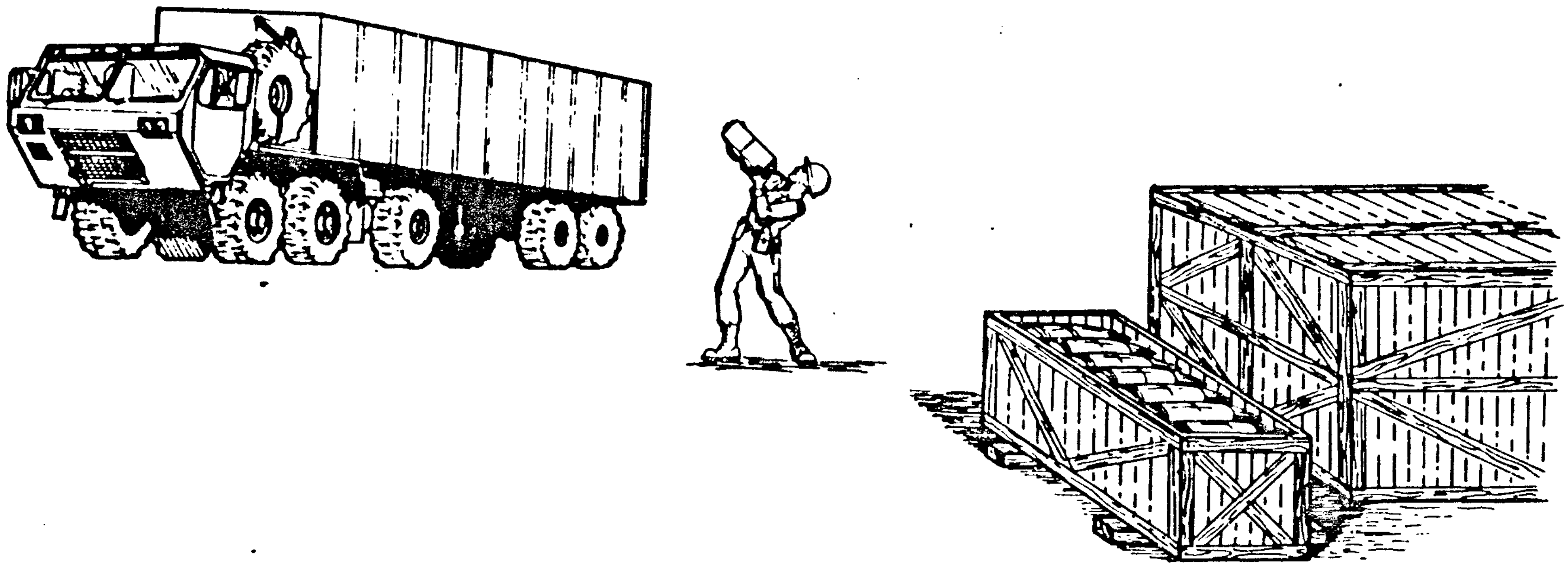
Ammunition Resupply Concept Resulted in Logistics Savings

- Reduced equipment, personnel, ATP burden



- Met ammunition supply rates to "Nth" day

15

Phase 1A ILS Studies Refined Ammunition Resupply Concept

FMC

72-hour Ammunition Time-Line Study:

- Suggested caisson not required with Howitzer
- Returned caisson to BTRY SVC for peak load
- Added additional truck to battalion
- Moved crane from caisson to ARV

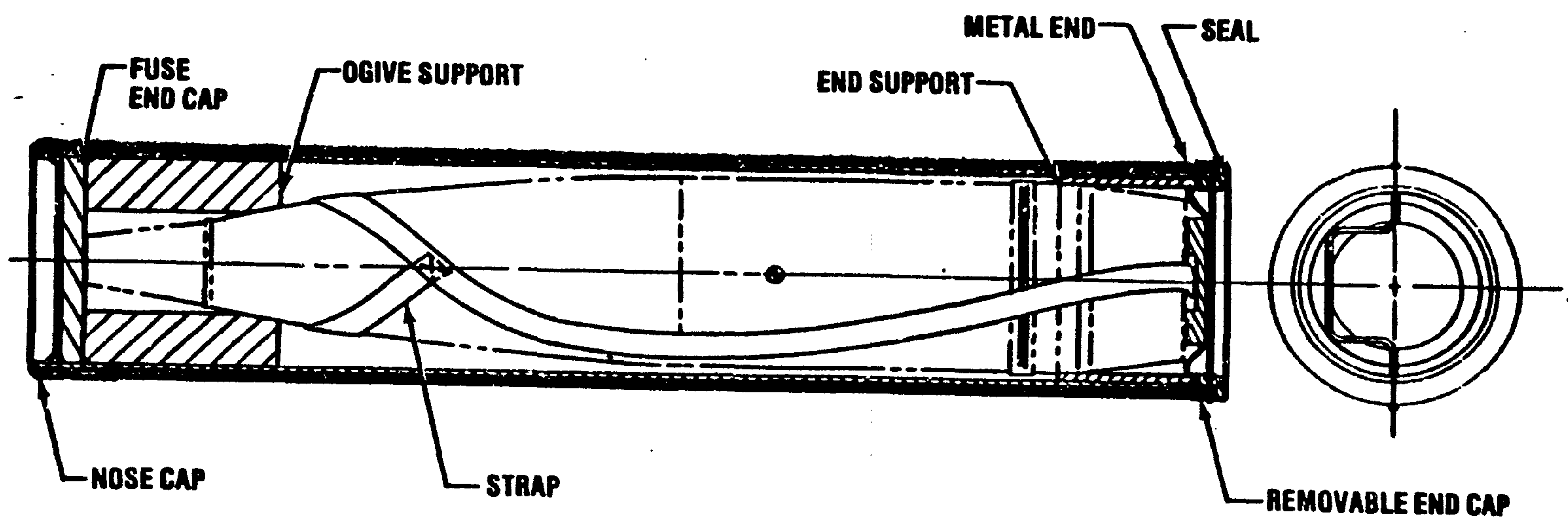
Phase 1A ILS Refined Ammunition Module Concept

FMC

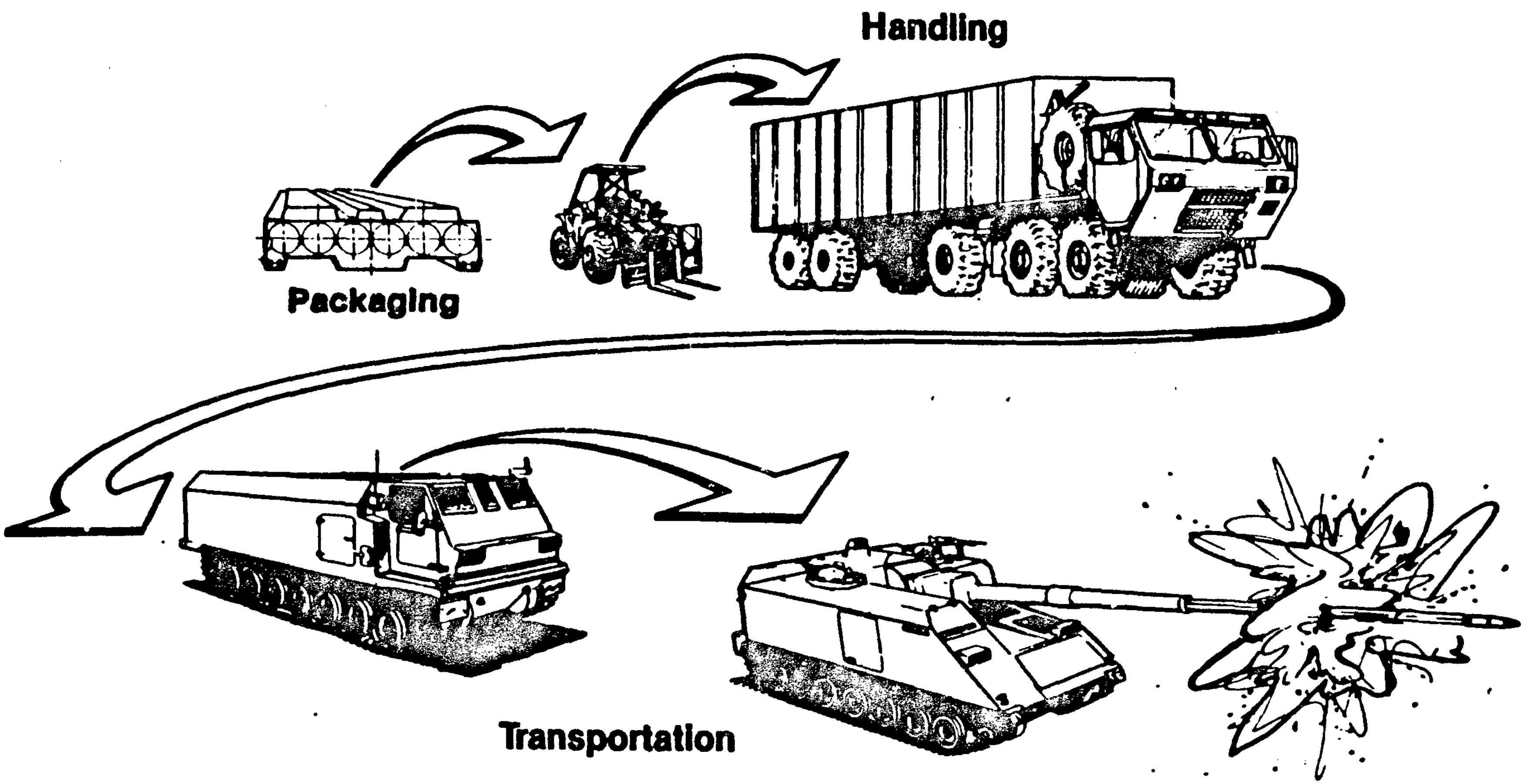
- Alternative concepts trade-offs show ammunition magazine module (AMM) the preferred concept
- Materials and structures trade-offs determined laminate composites and polymers to be preferred
- AMM concept benefits
  - Laminate composite tubes are strong, inexpensive and lightweight
  - Self-locking ends ease rapid removal
  - Polymer frame protects and is MHE compatible
  - AMM saves ammo renovation costs

Ammunition Magazine Module Concept

FMC



PHT Analysis Contributes Significantly to Future Weapons System Effectiveness



19

US ARMY HUMAN ENGINEERING LABORATORY
ABERDEEN PROVING GROUND MARYLAND
HEL

BATTLEFIELD ROBOTIC AMMUNITION SUPPLY SYSTEM

BRASS 2000

An overview briefing of
BRASS 2000 as presented
to the packaging, handling,
and transportability division
of the ADPA.

1983 Spring Meeting
NCEL, Port Hueneme, California

Mr. J. Stephens

Mr. M. Davall

Viewgraph #2

We will start off with a brief introduction as to where HEL is coming from in this particular field of endeavor. I will review the process we went through with TRADOC's Missile & Munitions Center & School in the development of the objective strategy for the Army's ammunition support structure which is named BRASS 2000. BRASS is at the first wicket, currently a concept statement at TRADOC HQ and of course there is a long way to go through the RDT&E cycle in order for a ROC to be prepared. In the overview of BRASS, we will focus on packaging and handling issues but BRASS has 3 technology thrust areas and we will touch on these. We will present our logic for what we term battlefield packaging and wind it up with a description of the BRASS robotics effort and set the scene for Dr. Knasel of Science Applications Inc who follows.

INTRODUCTION

DEVELOPMENT OF AN OBJECTIVE STRATEGY FOR THE ARMY'S AMMUNITION SUPPORT STRUCTURE

AN OVERVIEW OF BRASS 2000
A CONCEPT STATEMENT

FOCUS ON PACKAGING & HANDLING

INTRODUCING ROBOTICS

Viewgraph #3

Highlighted in our mission statement are those particular functions which bring us into the area of concept development, test bedding and also of course give us the responsibility to insert 6.2 tech base efforts in robotics into Army programs.

US ARMY HUMAN ENGINEERING LABORATORY
ABERDEEN PROVING GROUND, MD

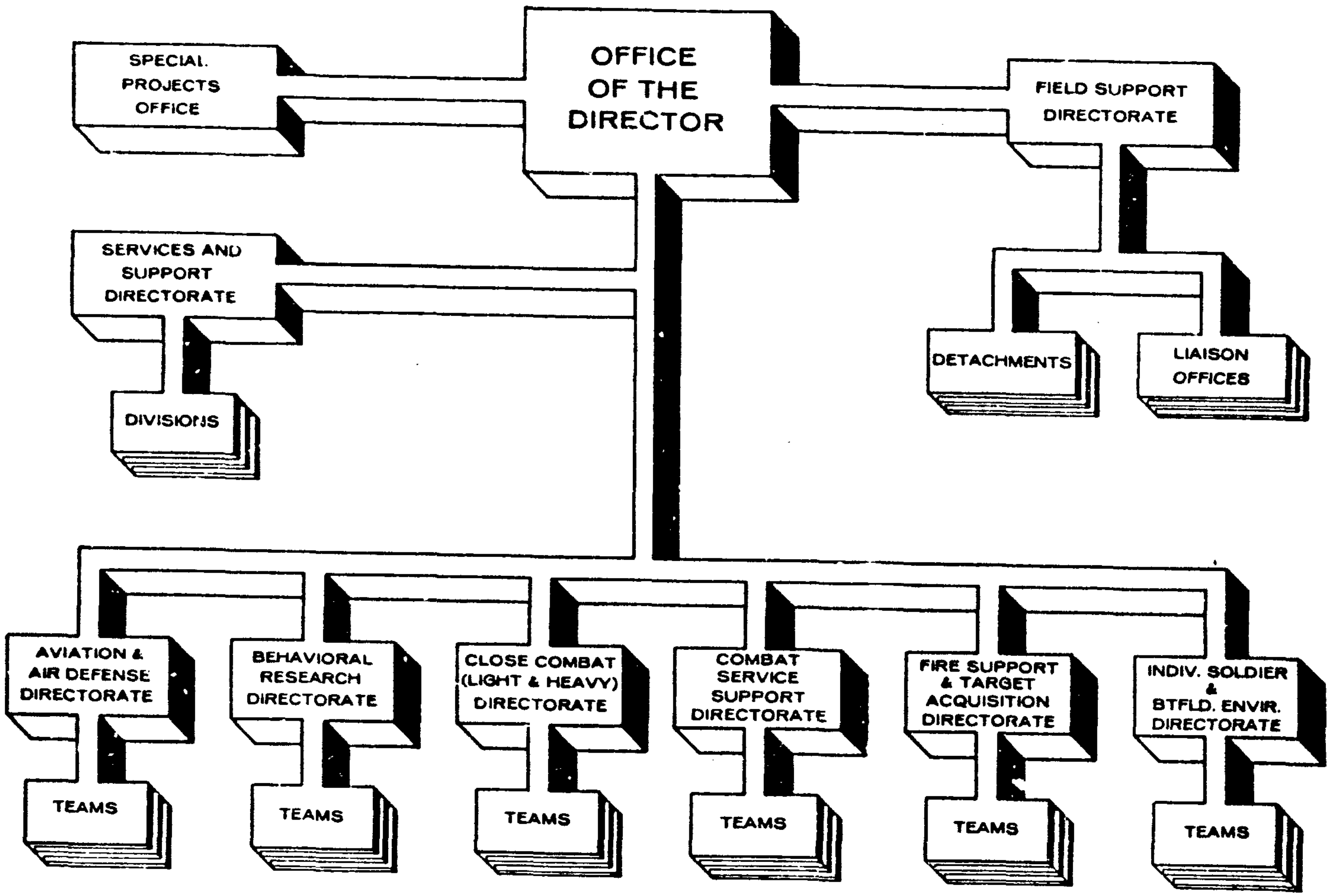
MISSION

1. TO CONDUCT HUMAN FACTORS RESEARCH.
2. TO INTEGRATE ARMY MANPOWER FACTORS INTO ARMY MATERIEL DEVELOPMENT PROGRAMS.
3. TO CONDUCT TOTAL WEAPON SYSTEM PERFORMANCE STUDIES.
4. TO CONDUCT MATERIEL CONCEPT FEASIBILITY STUDIES.
5. TO OPERATE A DOD-WIDE HUMAN FACTORS DATA BANK.
6. TO PROVIDE DIRECT HUMAN FACTORS ENGINEERING SUPPORT TO DEVELOPMENTAL CENTERS, PROJECT MANAGERS, AND US ARMY MATERIEL DEVELOPMENT & READINESS COMMAND (DARCOM).
7. TO SERVE AS LEAD AGENCY WITHIN DARCOM FOR MILITARY OPERATIONS WITHIN BUILT-UP AREAS (MOBA).
8. TO SERVE AS LEAD AGENCY WITHIN DARCOM FOR ROBOTICS.
9. TO PROVIDE DIRECT HUMAN FACTORS ENGINEERING INPUT TO PM'S TO ASSIST IN ORGANIZING, INTERPRETING, AND PRESENTING THE HUMAN FACTORS ENGINEERING ANALYSIS (HFEA) FOR EACH SYSTEM UNDER ASARC REVIEW. HEL WILL ALSO PROVIDE THE HEALTH HAZARD ASSESSMENT AND/OR BIOMEDICAL CONSIDERATIONS WHICH HAVE BEEN DEVELOPED BY USA MEDICAL R&D COMMAND IN COORDINATION WITH THE SURGEON GENERAL.

Viewgraph #4

HEL reports directly to DARCOM. Here you can see how the Human Engineering Laboratory is organized into Directorates. Behavorial Research Directorate, deals with our 6.1 basic research area. The other 5 combat directorates deal with mission areas intentionally arranged, as close as we could with available assets, to correlate with TRADOC's school and center proponency for the various elements of combat capability. As you can see Combat Service Support is organized at the same level as those which support the maneuver elements and fire support.

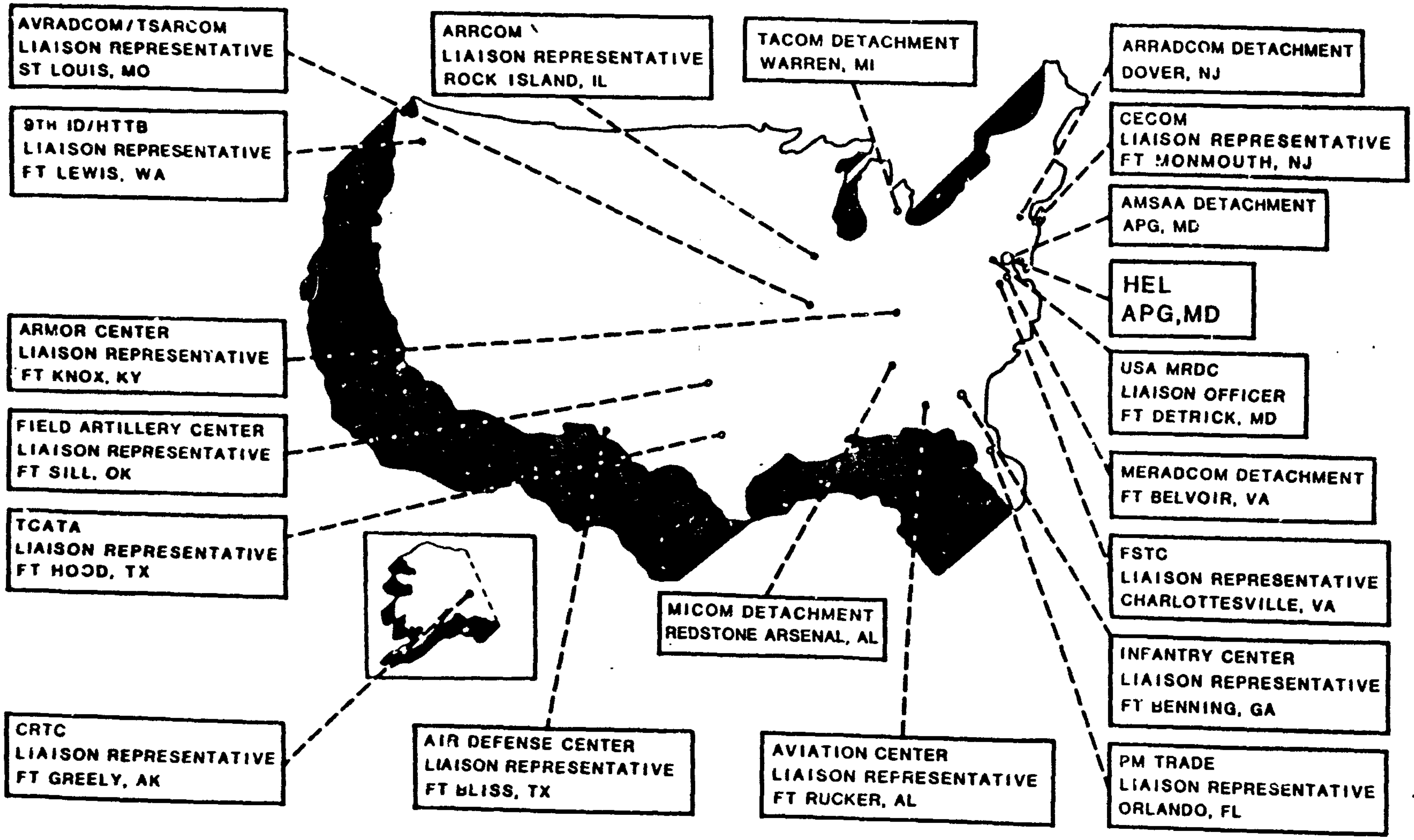
THE HEL ORGANIZATION



Viewgraph #5

Note that in addition to the corporate labs at Aberdeen Proving Ground, HEL does sustain a broad network of Detachments at all major commodity commands, and the liaison activities at the principal TRADOC schools and centers. This provides a network that allows us to do a unique job in system integration and work very closely across the entire DARCOM/TRADOC community in plying our trade.

HUMAN ENGINEERING LABORATORY DETACHMENTS AND LIAISON REPRESENTATIVES



Viewgraph #6

Within the Combat Service Support Directorate, these constitute our personnel assets and the way they are organized into teams. I call your attention particularly to the functions that are highlighted at the bottom of the viewgraph. In addition to the assets shown there, I want to specifically mention the contractor which we have supporting the HELFAST operation, Armament Systems Inc. and Mr. Mike Davall who leads that activity is here to help me today with, any questions that could emerge. Also we maintain a strong operating interface with the logistics support laboratory at Mobility Equipment R&D Command located at Ft. Belvoir, with both US Army Armament R&D Command and Defense Ammunition Center and School, Savanna, our TRADOC proponent for conventional ammunition, the Missile & Munitions Center & School at Redstone Arsenal and we maintain consultant arrangements with LTG(USA RET) Joe Heiser, probably the most widely acclaimed logistician of our time and BG(USA RET) Ostrom who has a unique history in the world-wide movement of ammunitionm in wartime.

COMBAT SERVICE SUPPORT DIRECTORATE
ORGANIZATION AND FUNCTIONS

CHIEF
JOHN STEPHENS

SECRETARY
COLLEEN DIXON

R&D COORD
LT COL DON NEMETZ

COMPUTER SCIENCE TEAM

G. HERALD - TEAM LEADER
J. GOMBASH
M. THOMPSON
B. GSCHWIND, SEC

- MANAGE COMPUTER RESOURCES
- HF RESEARCH IN MAN-COMPUTER TECH BASE

LOGISTICS SYSTEM TEAM

R. CAMDEN - TEAM LEADER
CPT D. HENDRICKS
P. KILDUFF
D. YENSAN
P. HARNDEN
B. GSCHWIND, SEC

- LOG SYSTEM MODELLING AND ANALYSIS
- APPLICATION OF AUTOMATION TO CSSD FUNCTIONS

HELFAST TEAM

VACANT - TEAM LEADER
P. HOLMAN
D. MACKEY
J. WAUGH
SFC J. TALKINGTON
D. MYSLINSKI
D. COALE, SEC

- RESEARCH, DEVELOPMENT AND EVALUATION OF PACKAGING, HANDLING AND TRANSPORTATION OF ARMY COMBAT MATERIEL

Viewgraph #7

For our work in combat logistics we maintain a test capability which we call the HELFAST Test Area at APG and it has done yoeman service in the past in allowing us to collect system performance data principally on the soldier/materiel handling equipment performance interface and cycle times for carrying out a wide variety of handling operations under field conditions. Mike Davall briefed this Division on the results of our forklift operator testing 2 years ago. Another important function under HELFAST is the operation, carried on jointly with MMCS, known as the HELFAST Quarterly Ammunition Seminars. This is the only mechanism that brings the doers of the ammunition support structure together on technical and integration issues. Both John Nunn and Elmer Kuhlman have attended some of these seminars in the past. If you think you would be interested in attending, please call or write me. Our next seminar is scheduled for 14-16 June at Aberdeen.

HELFAST II

A CONTINUING SERIES OF FIELD TRIALS STARTING FY83 INVOLVING THE PACKAGING, HANDLING, TRANSPORTATION, AND MANAGEMENT OF CONVENTIONAL AMMUNITION AT THE GS/DS LEVEL.

OBJECTIVE

DEVELOP TECH BASE AND SYSTEM/OPERATOR PERFORMANCE DATA ON EMERGING CONCEPTS FOR ASP/ATP ORGANIZATION, OPERATION, AND EQUIPMENT.

TYPICAL ISSUES

1. UCL MAKE-UP - TIME AND MOTION DATA FOR ASP/ATP CONFIGURATION AND EQUIPMENT CONCEPTS. 24-HOUR FIELD COMBAT CONDITIONS.
2. HEMMT LOAD CYCLES IN CONJUNCTION WITH 1.
3. NIGHT CRANE OPERATIONS AND LIGHTING REQUIREMENTS.
4. LOGMARS UTILIZATION IN THE FIELD.
5. CANDIDATE/SURROGATE CONCEPTS FROM INDUSTRY FOR:
   - A. COMPUTER/DATA DISTRIBUTION ENHANCEMENTS.
   - B. MHE.
   - C. PACKAGING, PALLETIZING, AND CONTAINERIZATION.

Viewgraph #10

Conceptually, the munitions system support structure is probably just as confusing as this viewgraph tends to be but we would like to focus your attention on the ASP . It is the interface between the wholesale and the retail systems for ammo resupply and for those of you who may not be familiar with this structure, I'll spend a moment on it. The user can either go back with his transportation assets to the ammunition supply point to draw his supplies or in the case of high volume, high tonnage items, artillery, tank rounds, and so forth, he can send his transportation assets back to the ammunition transfer points where the material is retained on S&P trailers and issued in pallet quantities. The ammunition supply point, of course, carries the entire inventory of ammunition that the combat user needs and that material is grounded.The approximately 3 to 5 days' supply of ammunition on the ground at the ASP leads to one of the basic problems that we have to address in trying to come up with a new system. The vulnerability and the immobility of ammunition supply point does not appear to be survivable on the modern battlefield. When we think about trying to change this system we encounter a tremendous number of Army elements that impact on its architecture.

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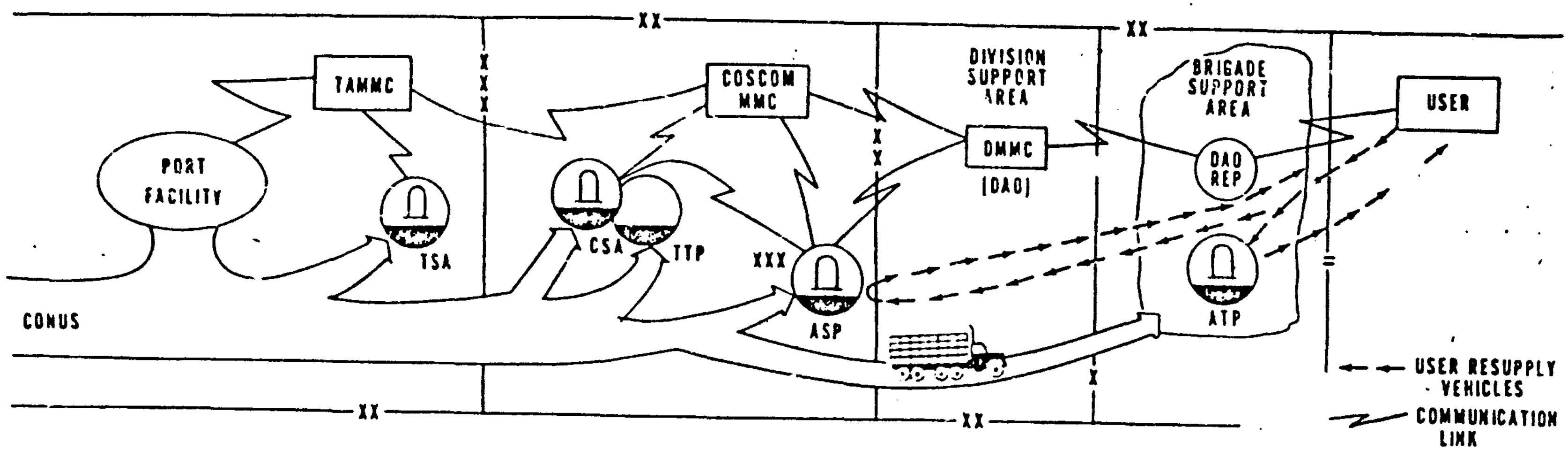


ATP - AMMUNITION TRANSFER POINT
ASP - AMMUNITION SUPPLY POINT
TTP - TRAILER TRANSFER POINT
CSA - CORPS STORAGE AREA
TSA - THEATER STORAGE AREA

NOTE:

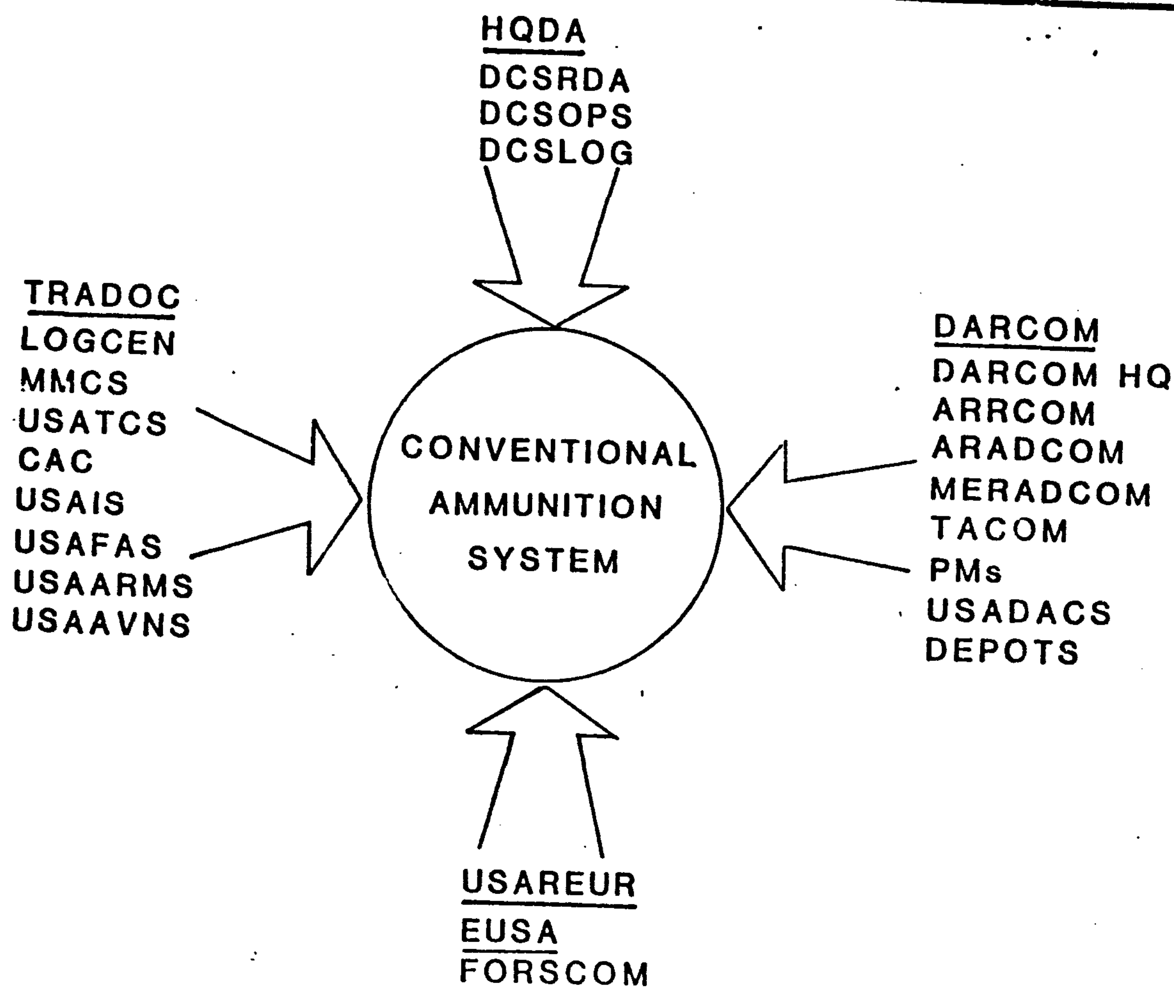
NORMALLY, THE TRUCK DISPATCHED FOR CLASS V SUPPLIES WILL PROCEED TO DAO REPRESENTATIVE AT THE ATP OR ON THE MSR TO THE ASP. SELECTED ITEMS OF CONVENTIONAL CLASS V SUPPLY ARE DELIVERED TO THE BRIGADE ATP, USING COSCOM TRANSPORTATION.

★ *Figure 9-2. Flow of conventional ammunition and high density guided missiles.*

Viewgraph #11

These are the major organizations that impact the ammunition resupply system, but no one is in charge. Through our efforts starting in 1979, the HEL Forward Area Supply & Transfer (HELFAST) Ammunition Seminars have become the principal information exchange and integration operation in this arena. It is from these working level seminars and from the results of MMCS' Mission Area Analysis (MAA) that we brought together the basic elements that formed the objective strategy for a new way of doing business - and we labelled it BRASS.

AMMO SUPPLY SYSTEM PLAYERS



Viewgraph #12

Although several blue ribbon studies have targeted the key ammo system problems we could find no movement anywhere in the R&D community that indicated any organized impending attack on these problems.

SELECTED AMMO STUDY FINDINGS

	AITF	CASPR	STARLOG
● AMMO HANDLING LABOR INTENSIVE FOR USER	X		X
● PACKAGING NOT SUITED FOR USER	X		X
● EXCESSIVE TURN-AROUND TIME AT ASP	X	X	X
● NO STANDARD MIS	X	X	X
● AMMO DISTRIBUTION BY CONTAINERS IS MHE CONSTRAINED	X	X	X
● COMMO AMONG AMMO OPERATORS	X	X	X
● PACKAGING INCOMPATIBLE WITH INTEGRATED BATTLEFIELD			X

Viewgraph #13

In addition to the problems themselves, one must take into consideration factors such as these as we structure any new system. The second bullet is us saying that we do not think it necessary to change the current wholesale packaging if we take into consideration an objective strategy like BRASS that will use the ammunition that is already out there. The field ASP is a tremendous area of ammunition stacks and to give it motility is probably less of an issue that finding ways of eliminating it. We have to accept the fact that much of labor force is in the reserve components and that the system is not realistically practiced in peacetime in order to find out what's working and what isn't. Also we must now face the issue of operating on the integrated battlefield - someone's unemotional term for the nuclear, biological and chemical threat.

OTHER FACTORS BEARING ON AMMO RESUPPLY

- CURRENT INVENTORY TOO EXPENSIVE TO REPACKAGE
- CURRENT PACKAGING UNLIKELY TO RADICALLY CHANGE
- NEW WEAPONS AND PREDICTED FIRING RATES WILL INCREASE SURGE DEMANDS
- FUTURE BATTLEFIELD WILL REQUIRE A HIGHLY MOBILE AMMUNITION SUPPORT SYSTEM
- AMMO SUPPORT UNITS IN RESERVE COMPONENTS
- NBC THREAT
- NOT REALISTICALLY EXERCISED IN PEACETIME

Viewgraph #14

When we examined those problems, we felt that they could be lumped basically under 3 technical areas. The titles themselves constitute some shorthand in that packaging really conveys packaging, handling, and transportation. And those problems which are scored under automation deal with command, control, communications, and computer automation, C to the 4th. Robotics right now is a stand alone because it's new; eventually it would become, as it matures, part of the handling technology.

ADDRESSABLE PROBLEMS BY CATEGORY

	PACKAGING	AUTOMATION	ROBOTICS
AMMO HANDLING LABOR INTENSIVE	X		
PACKAGING NOT SUITED FOR USER	X		X
EXCESSIVE TURN AROUND TIME AT ASP	X	X	X
NO STANDARD MIS		X	
AMMO DISTR BY CONTAINER			X
COMMO AMONG AMMO OPERATORS		X	
INCOMPATIBILITY WITH INTEGRATED BATTLEFIELD	X		X

Viewgraph #15

It is no accident that these kinds of problems group themselves under the same 3 tech areas as fell out of the mission area analysis performed by the TRADOC proponent. This was due to a very close working relationship between a TRADOC and a DARCOM agency that were trying to come up with the support plan that TRADOC has to surface as the bottom line of its mission area analysis.

MAA/BRASS INTERFACE

- PACKAGING :
  - LOADS CONFIGURED TO MEET CUSTOMER NEEDS
  - STANDARDIZED PALLETS
  - TRANSPORT OF "BARE" ROUNDS ("RACS")
- AUTOMATION :
  - EXPANSION OF SAAS -4 (TRUCK LOADING, ETC.)
  - IMPROVED COMMUNICATIONS/DAO CAPABILITY
  - AUTOMATED ASP OFFICE - "PAPERLESS SYSTEM"
- ROBOTICS:
  - REDUCED PERSONNEL REQUIREMENTS
  - LOADS CONFIGURED "ON DEMAND"
  - INCREASED MOBILITY OF RESUPPLY MODULES

Viewgraph #16

These are some of the steps required hand-in-hand with TRADOC to come up with a good support plan. In the conduct of the mission area analysis, there is much system performance data, there are models and many other tools that are available within DARCOM that the TRADOC component can use. In the ammunition area there were severe data voids in system performance and HELFAST I collected a good bit of that data. When the MAA process surfaces the shortcomings and deficiencies and begins to structure the support plan DARCOM must be able to read and understand the impact of those deficiencies and shortcomings on the system and provide the technical and materiel opportunities that can be available downstream around which TRADOC can develop an objective strategy. BRASS 2000 is a concept or an objective strategy at this stage of development.

TRADOC	DARCOM
CSSMAA	SYS PERF DATA MODELS ETC
SUPPORT PLAN	READ & UNDERSTAND
DEVELOP OBJECTIVE STRATEGY & CONCEPTS	PROVIDE TECH & MATERIEL OPPORTUNITIES CONCEPTS
PRIORITIZE ISSUES	IDENTIFY TECH DATA VOIDS
SUPPORT	PROPOSE TECH BASE EFFORT

Viewgraph #17

There are persistent deficiencies across all of the major studies over the past 7 or 8 years and they cannot be fixed with bandaids. They are systemic in nature. Field Artillery Armored Supply Vehicle (FAASV) is a good example of how the logistic support structure in ammunition is constraining the weapons system designers as they approach certain aspects of their weapons system design because of the way they have to receive their ammo. They really do not want to stuff magazines manually in the combat trains and right now the logistician has no means by which he can take on that responsibility, so we're in kind of a standoff. The other basic conclusion is that ammunition supply technology cuts across such a broad line of mission and areas that it constitutes a whole new challenge as far as managing is concerned. It's almost like the problem the Army faced in learning how to manage the C3 area, trying to find out who's in charge, and who can do the systems integration work.

CONCLUSIONS

1. THERE ARE SOME PERSISTENT DEFICIENCIES THAT MUST BE ADDRESSED
2. SINCE NO NEW TECHNOLOGY HAS BEEN APPLIED TO GS/DS AMMUNITION RESUPPLY LOGISTICS SINCE WW II, IT NOW CONSTRAINS HIGH-TECHNOLOGY WEAPONS DESIGN AND LIMITS THE REALIZATION OF FULL COMBAT POTENTIAL.
3. SOLUTION MUST CUT ACROSS WEAPON SYSTEM LINES AND TECHNOLOGY AREAS IN A SYSTEMS APPROACH TO AMMO RESUPPLY

Viewgraph #18

A definition of BRASS 2000.

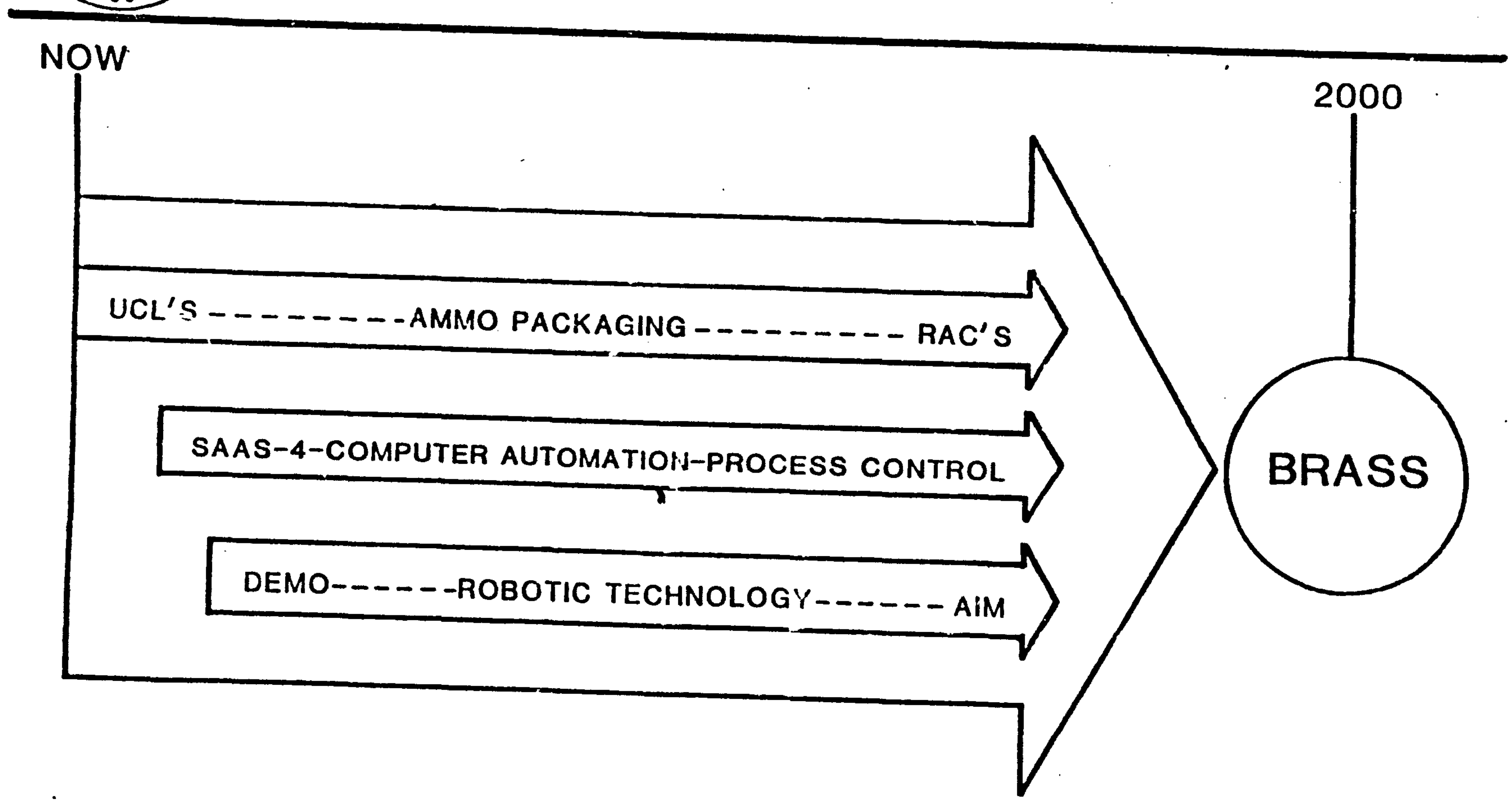
BRASS 2000

A CONCEPT FOR A SYSTEM UTILIZING HIGH TECHNOLOGY TO PROVIDE A MOBILE INTERFACE BETWEEN THE GENERAL SUPPORT AMMO UNITS AND THE COMBAT USER. BRASS WILL EMPLOY IMPROVED COMMUNICATIONS, COMPUTER AUTOMATION AND PROCESS CONTROL OVER AUTOMATED AND ROBOTIC MODULES FOR PROVIDING USER PACKS AND MAGAZINES CONSISTENT WITH FUTURE BATTLEFIELD AMMO DISTRIBUTION REQUIREMENTS

Viewgraph 19

This is a roll up of everything that's associated with the BRASS concept and I would like to spend a little time going through this as a whole before I come back and try to focus on ammunition packaging. If we look out to around the year 2000 and we try to stack up the capabilities that are going to be required of an ammunition support structure for the airland battle and beyond, you'll see that we are talking about, ready-round ammunition containers or magazines. In the computer area we are talking about total process control and as far as the robotics thrust is concerned we are talking about fielding an AIM, an Ammunition Issue Module, which is the basic building block of the BRASS concept. We're already started in the packaging area by exercising the unit configured load concept although it's a non-materiel thrust. It's a first and very important step in having the logisticians begin to perform certain services. In this case the preconfiguration of pallet loads of ammunition into truckloads that can be more rapidly issued to the user. We're not really quite started in the computer area because SAAS IV has not been automated yet, the TACCS (Tactical Army CSS Computer System) is supposed to do it in a couple of years but there is a long row to hoe before we can provide computer automation of the ASP paperwork process and go to the next generation of capability which is to have that ability to exercise total process control over the AIM. And, of course, we are close to a start in the demonstration phase of robotic technology through a program which is currently underway which I will introduce you to and which Dr. Knasel will discuss in more detail. Of concern to us is that in order to arrive at the ultimate capability reflected in the BRASS concept, all three of those tech areas have to move together in a coordinated and integrated manner.

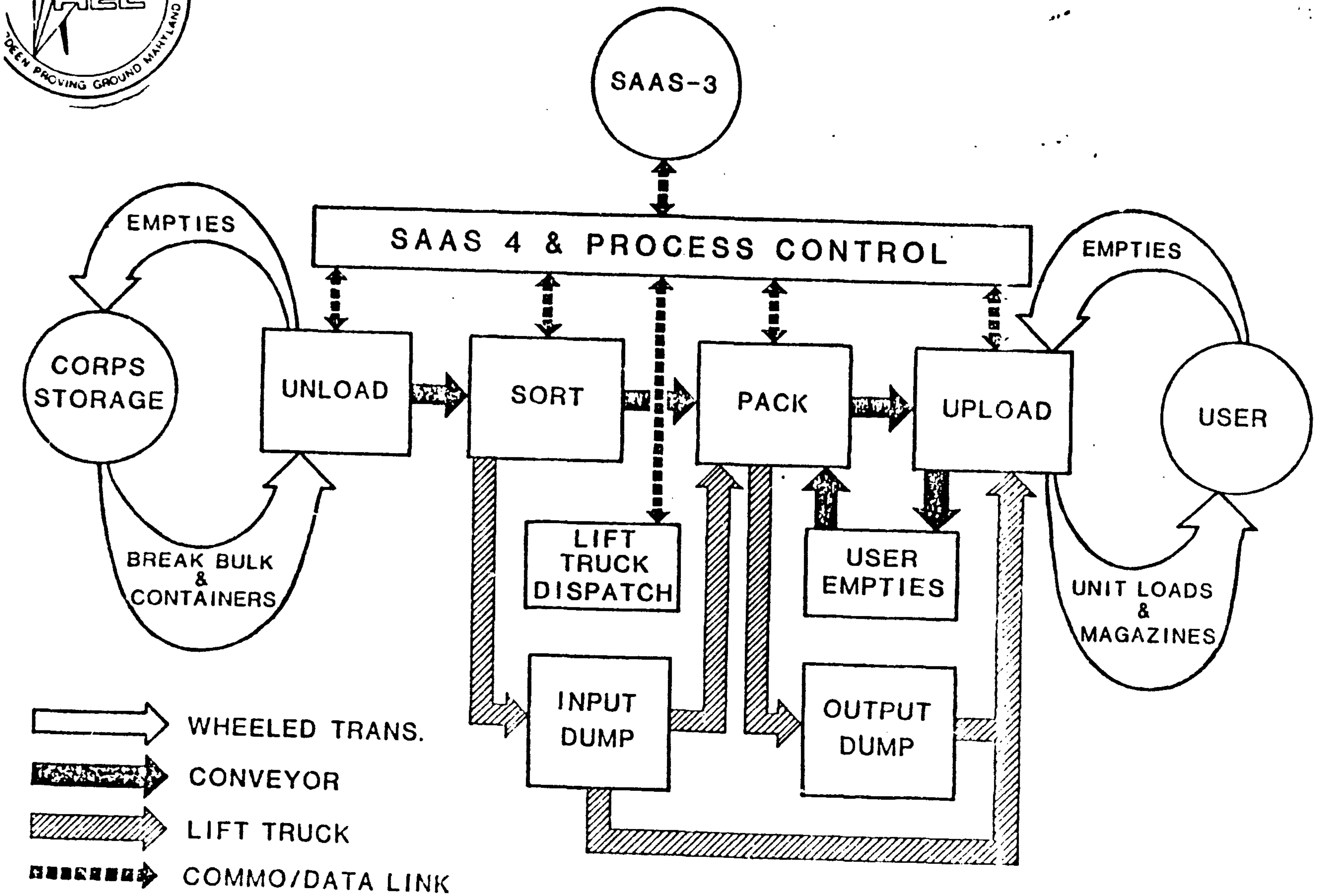
BATTLEFIELD ROBOTIC AMMUNITION SUPPLY SYSTEM



Viewgraph #20

In the lower right-hand corner of the previous viewgraph, we introduced you to the acronym "AIM", the Ammunition Issue Module, and here, I want to discuss briefly, the flow that takes place within that module for this is the essence of BRASS. We're portraying the transportation loop from corps storage, or it could be from further back, to the first part of the AIM cycle as providing both break bulk and container loads of ammunition. In either case, they are homogeneous pallet loads packed on either S&P trailers with blocking and bracing or they're stuffed in MILVANS or ISO 8x8x20 containers with dunnage and cribbing. In order to have this transportation cycle operate as efficiently as possible, it will be very important to eliminate delays in that unload cycle. We'll talk more about the container issue when I get further into packaging. The top blocks represent 4 basic functions that have to be performed within the AIM, the upload being the reverse of the unload and then some more or less classical warehousing, picking and placing, that has to be done in the military context of what can currently be done in the commercial field. On the output side, we target being able to pack weapon interfacing magazines, and unit loads or ready-round ammunition containers, uploaded and ready to go the minute the user shows up for them. We show two buffers here although the rules of "just in time management" say that if you were doing a superb job the input and the output wheels would turn in mesh and you would require no buffering. In recognition of the transients which will take place in the arrival of trucks due to clogged main supply routes, enemy action, drivers getting lost and so forth, it appeared that the input dump would have to hold, on the ground or on wheels or some combination thereof, 6 to 12 hours of resupply in commodity loads. The output dump would have to hold somewhere between 2 and 4 hours of battlefield packed ammunition ready to be issued to the using units. These are microscopic in terms of weight and storage requirements as compared to the 3 to 5 days supply currently required for an ASP. The output dump would not be dried up upon an order to move, it could be left for the user to pick up with his HEMTT's 10-ton trucks with on board crane. The input dump could be moved at a later date by other resources so the functional part of the AIM could pick up and move readily. That completes the general overview of the BRASS we will now zero in on the packaging issues related to BRASS.

BRASS 2000 - AMMO ISSUE MODULE (AIM)

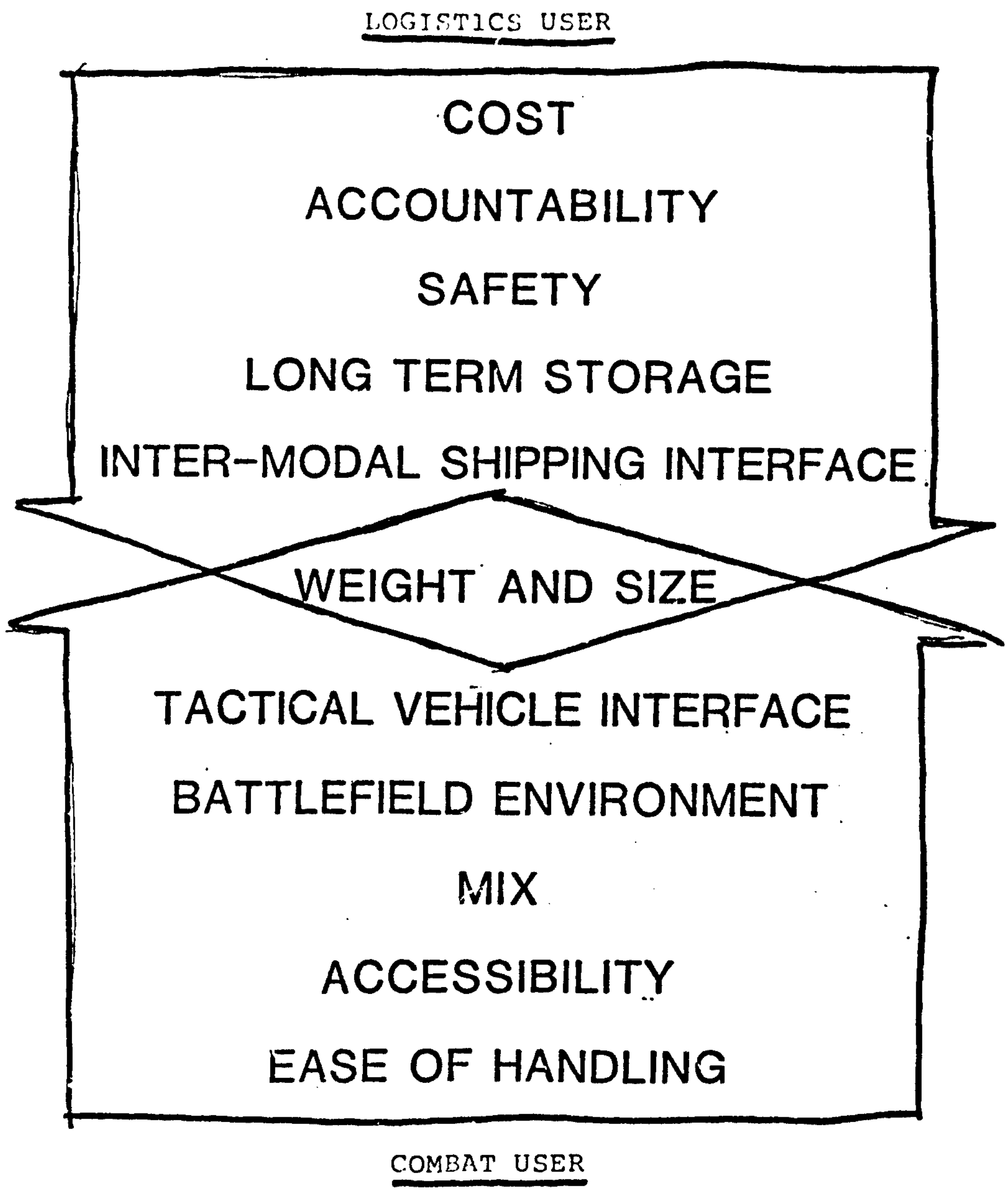


Viewgraph #21

When we start talking about user friendly packaging of ammunition, we generate a potential problem. If we are talking about low cost, high volume, ammunition, artillery, tank rounds, and so forth, when the logistician looks at the types of packaging that satisfy his needs, he sees the kinds of features shown from the top down and shares a joint concern with the combat user for weight and size. They are, otherwise, totally different from what the combat user would like to see when he looks at a package of ammunition. He's concerned with the mixes, the accessibility and ease of handling, how it survives in the battlefield environment and how it interfaces with his combat and transport vehicles. Any attempt to combine features of one world with the other almost invariably result in an increase in weight, or cube or cost or all of the above, and results in unwanted, and in our opinion, unnecessary trade-off compromises thru the imposition of an artificial constraint - a mindset that says you're only going to package ammo once in its lifetime. We think it is very important that we begin to separate the functional worlds of those two classes of ammunition packaging and on the next viewgraph.

AMMUNITION

PACKAGING FEATURES



Viewgraph #22

We see that there are more likely three actual categories of ammo packaging. MLRS is an example of the system pack where the cost, the complexity and the nature of the basic round is such that it is justified to shoot from the container. Presently most of ammo packaging lies in the second category, the wholesale pack. It was designed to provide features of low cost, long-term storage and to meet stringent DOT and international requirements for movement in the highway, railway, and sea transport systems. This is the kind of packaging that Phil Korman designs. We feel eventually that pack is going to stop somewhere in the theatre, and what emerges as a third class of packaging, the battlefield pack, takes over at that point. It is the purpose of the AIM to make this conversion, providing ready ammunition to the combat user in packs suited to his immediate needs, with mission driven mixes, inherently adaptable to design changes in either the rounds or the weapons that fire them. In designing for this category of packaging the designer would be freed of the constraints imposed upon the wholesale packer.

BRASS 2000

PACKAGING AND CRATING

CATEGORY	CONUS PLANT	LONG TERM STORAGE	IN-THEATRE TERMINUS	COMBAT USER	FEATURES
SYSTEM PACK					SHOOT FROM CONTAINER
WHOLESALE PACK					LOW COST BULK PACK BULK PROTECTION
BATTLEFIELD PACK					MISSION MIXES IN RACS & MAGAZINES

Viewgraph #23

With the new role of MMCS as the TRADOC ammunition systems manager, TRADOC should be in a position to help the industry sort out the options for achieving the highest level of effectiveness in their resupply concepts. If we are to achieve the ability to field magazines for future tank and artillery weapons and mission tailored racks for maneuver elements operating on the airland battlefield, we must get started now.

SYSTEM INTEGRATION

- PACKAGING OF AMMUNITION COMES FROM MANY PLACES. OFTEN DESIGNED BY CONTRACTORS FOR A VARIETY OF PM'S.
- THE ARMY MUST COMMIT ITSELF TO A LONG-RANGE OBJECTIVE STRATEGY FOR AMMO RESUPPLY.
- CONTRACTORS MUST UNDERSTAND THIS SYSTEM AND INSURE THEIR DESIGNS ARE INTEGRATED WITH THAT STRATEGY.
- BRASS CAN PROVIDE A NEW SET OF OPTIONS AS TO HOW AMMO CAN BE PACKED AND DELIVERED TO THE COMBAT USER.

Viewgraph #24

FM 100-10, the March 83 version, gives us a good place to start where it says "the layout of the ASP provides for one-stop loading of resupply vehicles whenever possible". This doctrine anticipates somewhat the success of the unit configured load concept which we and MMCS will be subjecting to field trials this summer. We will be examining the workload and MHE required at a dedicated field storage unit in the ASP to set aside preconfigured user truckloads which is that part of his resupply needs that can be forecasted and treated as a push package. This type of operation is not as straight forward as it would appear on the surface but if we can work it out, the payoff will be substantial.

AMMO PACKAGING

NEAR TERM

- UNIT CONFIGURED LOAD (UCL)
  - INITIAL APPLICATION TO TANK, INF (M) UNITS
  - NO REPACKAGING, ISSUE PALLETS & BOXES
  - MIX DETERMINED WITH DAO
  - COMBAT LOAD IS ASSEMBLED AT ASP FIELD STORAGE UNIT
  - ONE STOP SHOPPING IN ASP
  - USER GETS COMBAT LOAD FROM ASP

Viewgraph #25

In the middle of that packaging timeline, we begin to see these kinds of capabilities emerging. I will note that plastics are shown in the first bullet under technology R&D due to the leverage that they currently enjoy as a relative newcomer. Concepts that can truly demonstrate significant reductions in weight or cost or both and adaptability to the battlefield will be sought no matter of what they are made. The essential point is that at long last research funds to promote tech base efforts in packaging are being worked up in the budget as well as the mechanism for managing them.

AMMO PACKAGING

MID TERM

- PACKAGING TECHNOLOGY R&D
  - MATERIALS R&D (PLASTICS)
  - PALLET/CONTAINER/MAGAZINE CONCEPTUAL DEVELOPMENT
  - DECONTAMINATION
  - CAMOUFLAGE
  - STORAGE/SAFETY
- LEADING TO CAPABILITIES
  - REPACKING 105/120mm TANK RDS, 155mm/8" ARTY RDS
  - INTEGRATION WITH FAASV, AFARV, HEMTT
  - LESS DUNNAGE FORWARD
  - SHORTER TURN AROUND TIME AT ASP/ATP
  - NO TRANSLOADING AT BN TRAINS

Viewgraph #26

As we look further out as robotics technology comes aboard, weapons interfacing magazine reloads should become a viable option over the current practice. Our hosts - FMC - are starting to look at this problem in conjunction with their development of the Armored Forward Area Resupply Vehicle (AFARV).

AMMO PACKAGING

FAR TERM

- PALLETS, MAGAZINES AND READY ROUND CONTAINERS (RAC) FOR SHIPPING "BARE" ROUNDS FORWARD
- PALLETS, MAGAZINES, RAC PACKED AT AMMUNITION ISSUE MODULE (AIM) AT GS/DS UNIT
- AMMO CONTAINERS COMPATIBLE WITH FAASV, AFARV,HEMTT AND WEAPONS SYSTEMS

Viewgraph #27

Now, as a reminder, packaging cannot stand alone. I did not want to go onto the robotics issues without passing back through that center arrow for computer automation again as a key tech thrust area for BRASS. None of the 3 technical areas can stand alone if the objective strategy of BRASS is to be realized and these capabilities ultimately have to be assembled in the computer area to apply to the BRASS system.

COMPUTER AUTOMATION

BRASS REQUIREMENTS

- COMPUTER
  - MULTI-USER
  - SURVIVABLE
  - INTERFACE WITH MACHINES
- FUNCTIONS
  - STOCK CONTROL, ACCOUNTING AND REPORTING
  - OFFICE PROCEDURE AUTOMATION, TRUCK LOADING
  - PROCESS CONTROL OVER MACHINES
- COMMUNICATIONS
  - COMMAND & CONTROL
  - AMMO OPERATORS – COMBAT UNITS, DAO, DMMC, ATP, ASP, COSCOM, MCC
  - TIMELINESS VS VOLUME

Viewgraph #28

Where system requirements dictate packaging of ready-to-fire rounds at the load plant and the penalties for transporting and storing those packages world-wide can be justified, then by all means the system designers should meet the challenge head on as in the case of MLRS. In a large percentage of the cases however, with high volume, low cost rounds, such provisions are neither feasible nor justified. BRASS attempts to meet this challenge head on. Anything short of this leaves us right where we are today - manually handling one round at a time, somewhere in theatre and right now this at the guns. There is no way to reach the BRASS objective short of fielding automated robotic machines for handling and packing in theatre and we must learn how to take advantage of robotics technology to give us that capability. In addition to these kinds of general features in robotics that are well-recognized, the AIM could have in its robotic modules the capability of being warehoused in a Pomcus situation, or, in an RDF situation, mounted on shipboard, they can be stashed in villages, and they would possess a rapid turn-on capability.

ROBOTICS CHARACTERISTICS

- SMART/REPROGRAMMABLE MHE
- OPERATES IN ENVIRONMENTS HOSTILE TO HUMANS
- INCREASED PRODUCTIVITY

Viewgraph #29

Because of the need we felt to experiment with robotics MHE and the need to bring attention to the applicability of this technology to logistics systems we decided to go after some near-term demonstration funds that DARCOM and TRADOC had been prioritizing and we presented the unload portion of the ATM as the one that we felt had the greatest promise. If we could demonstrate the ability to offload S&P trailers and unstuff containers in theatre, rapidly, it would have alot of interest to the logistics community as a whole not just to ammunition. It is a well-defined problem in that we know exactly what the loads are that are going to be coming into that unload module. The container loads and the S&P trailer loads are very carefully specified so there were no unknowns on the input side. It is labor intensive and there's a current need even if the rest of the BRASS system is never realized. That ability to provide a highspeed terminus for unstuffing containers is a capability that would be well received and it does push the state-of-the-art as Dr. Knasel will be discussing as soon as we get through.

ROBOTICS IN AMMO RESUPPLY

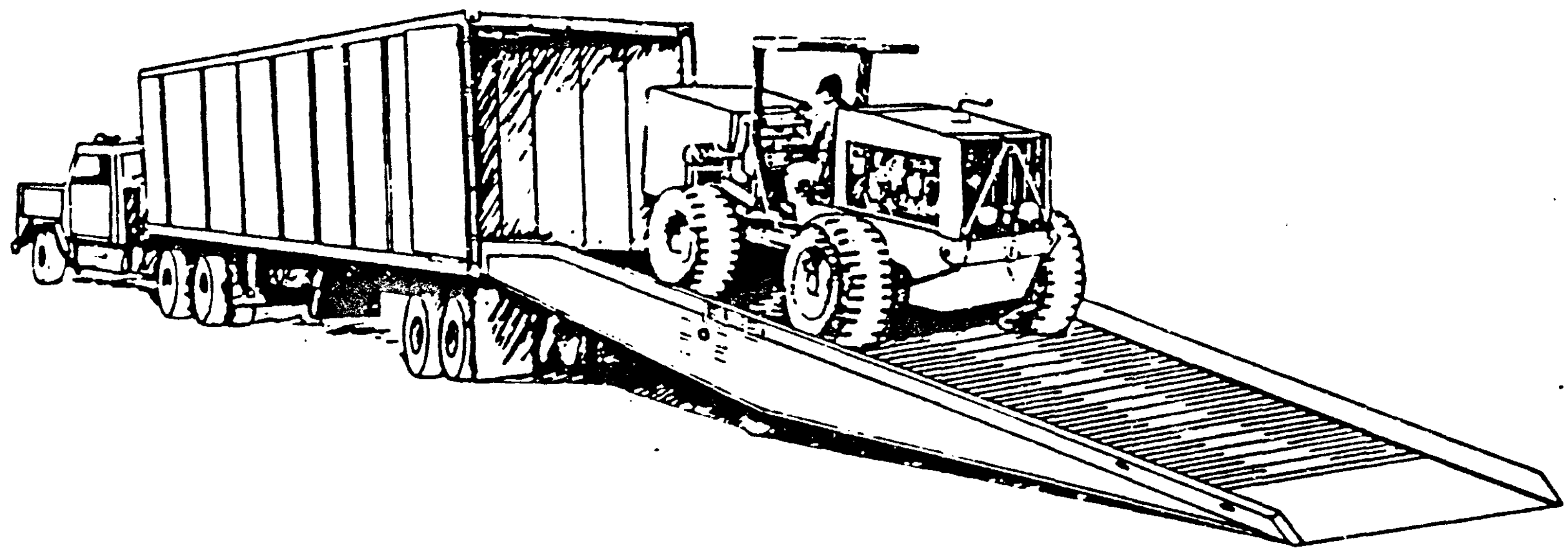
NEAR TERM

- FRONT END ANALYSIS–ILR FUNDED
- ANALYSIS AND DEMONSTRATION OF TRAILER/CONTAINER UNLOADER
  - APPLICABLE TO OTHER SUPPLY CLASSES
  - WELL DEFINED PROBLEM
  - LABOR INTENSIVE WORK
  - NEED EXISTS
- PUSHES ROBOTIC STATE-OF-ART

Viewgraph #30

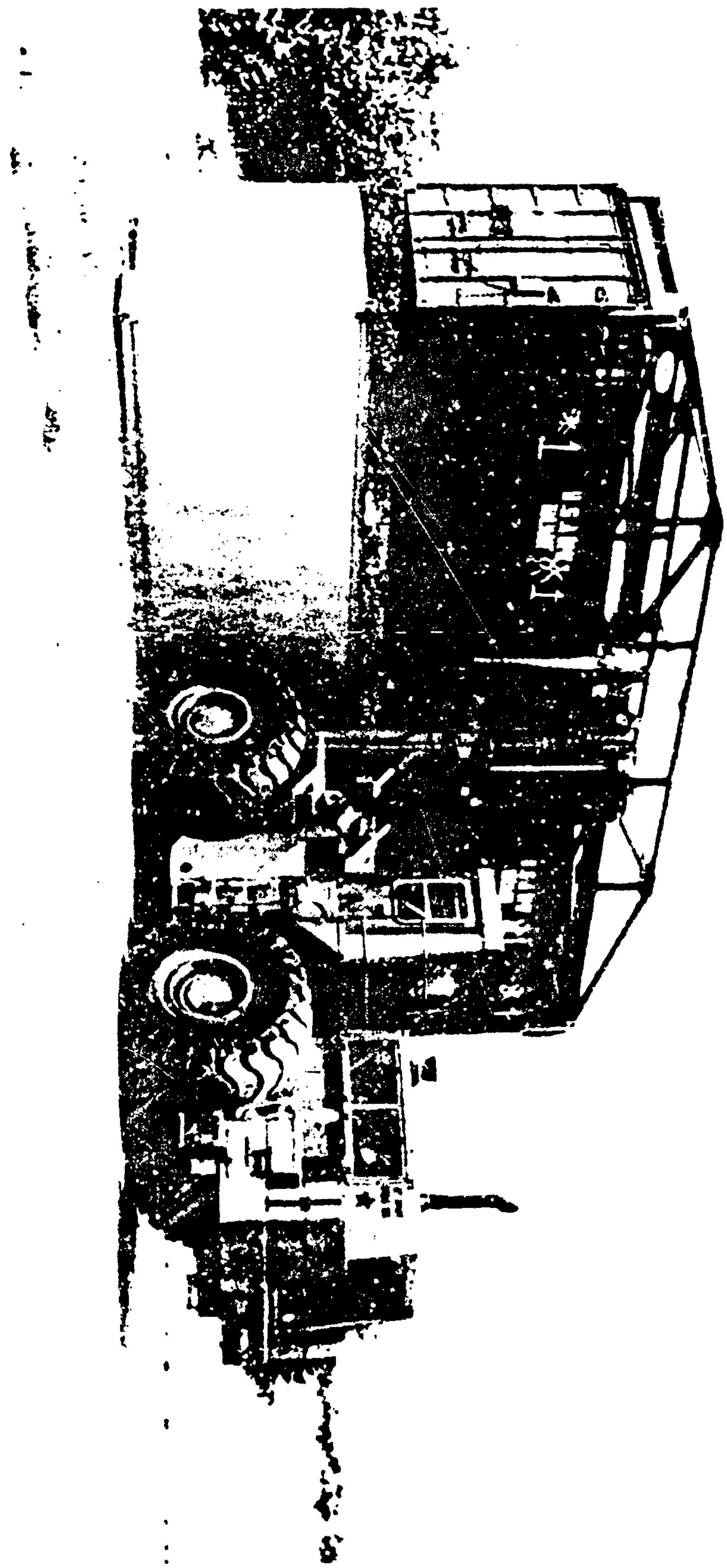
To dig just a little deeper into that question, the importance of the unloader can be seen in these next 2 viewgraphs. Currently, if containers brought forward are left ungrounded they must be unstuffed using a 5200# ramp and a 4-K shortmast RTFL. It takes upwards of 45 minutes for a crew to clean it out. The alternative is seen in the next viewgraph.

53



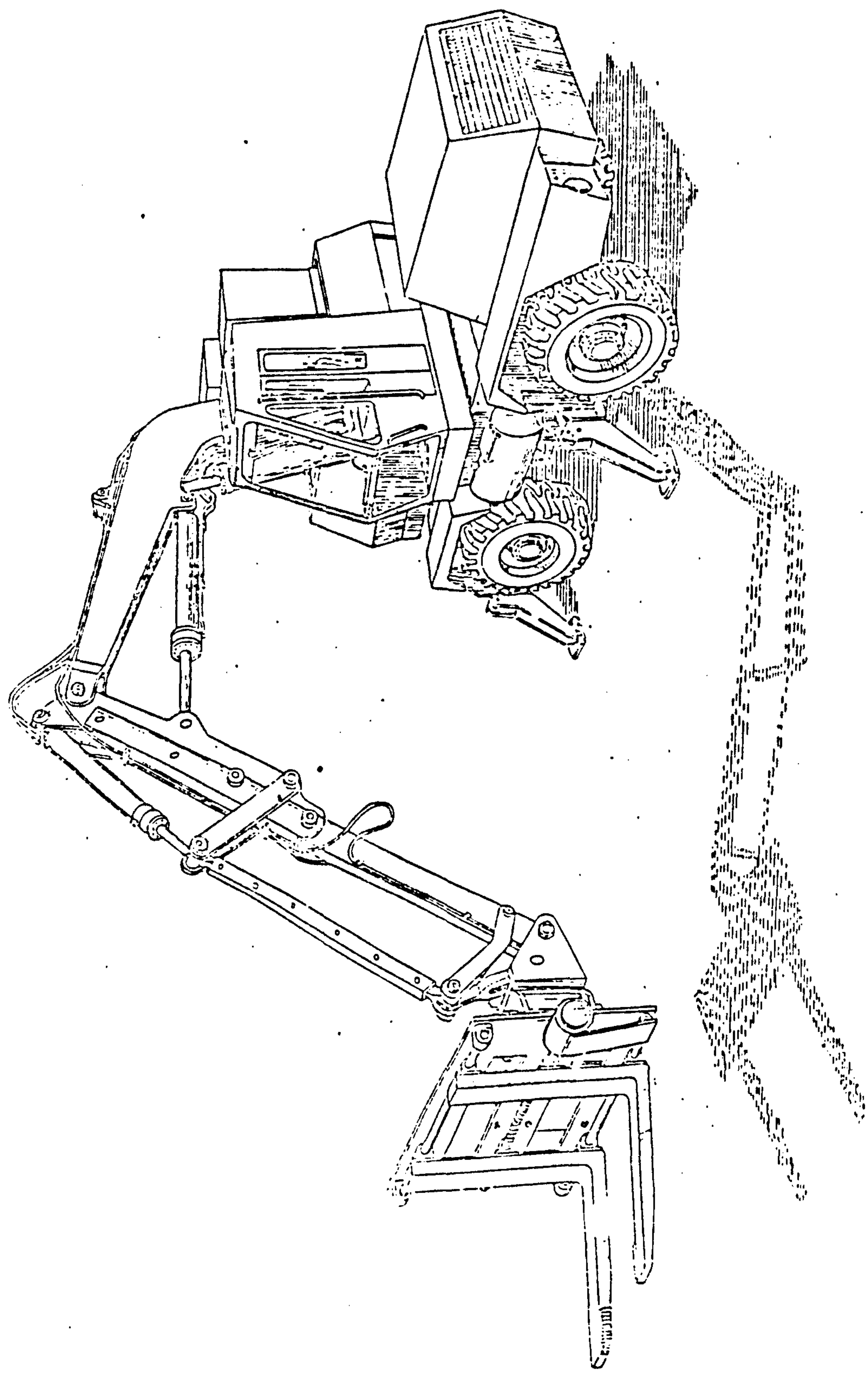
Viewgraph #31

The alternative to leaving it on the trailer of course is to ground it. But to ground such a container requires the use of equipment such as this 50K RTCH. Its ability to operate in the ASP is not good, in addition to what it does to traffic ability in the ASP. It also requires tear-down in order to be transported from one site to the next on a low boy.



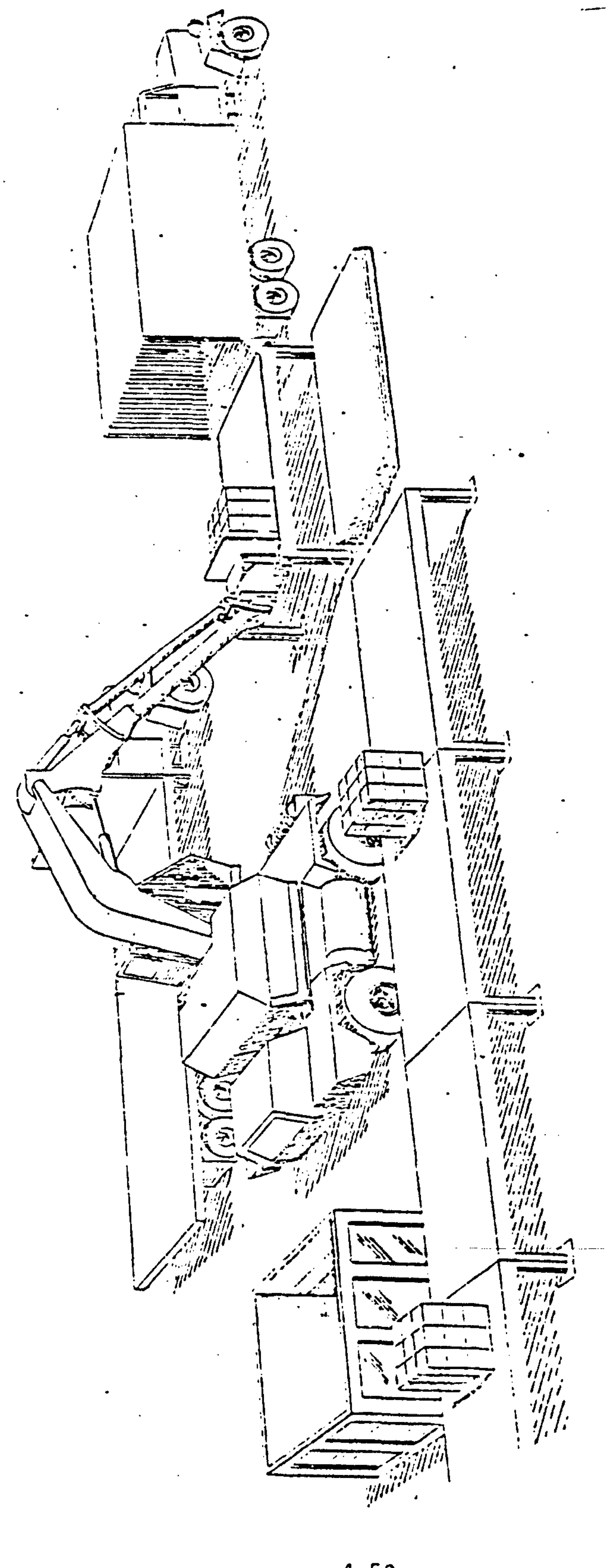
Viewgraph #32

Therefore, it appears that if we are to take the job of receiving containers in the ASP seriously we must be ready to handle the contents with the containers still on their trailers, and be able to unload block and braced S&P trailer loads or unstuff containers so rapidly that these corps transportation assets can immediately head back for resupply. It was on this basis that we did select the unload function to demonstrate the application of robotics to this kind of heavy field logistics. We have a lot to learn about using this kind of equipment - there are safety considerations, there are man-machine interfaces, both in teaching it how to unload a particular load and in terms of backing it up when the system degrades. You will note that the current concept employs an articulated boom rather than a shooting boom. How do you get inside a container with an articulated boom? We do not.



Viewgraph #33

We'd like to explain that there is under development for the wholesale ammo uploading of containers in CONUS, the PALS concept, the Prestaged Ammunition Loading System, being developed by MERADCOM with DACS Savanna through a contractor in Carisle, PA, ATS. The intent of the PALS system is to provide for the rapid uploading of containers using hard automation and some robotics and about 15 minutes to upload a container using integral dunnaging, where-in the entire load would be set into the container as a unit by some type of a roller mat loading device. It would be 8x8x20 ISO containers with the necessary bracing, side cribbing and in-between pallet cribbing to allow the entire load to be set up on the dock and then in a sense pushed into the container. When we began with MERADCOM exercising the SAI contract for looking at the concept for the robotic unloader it became apparent that the cost and complexity of reaching into the container was potentially unnecessary if one could drag them out as a unit and work on them in the same manner as you would offload an S&P trailer. Those differences justified taking another look at PALS in terms of the employment of slip sheets under those loads. so that the entire load could be extracted onto a dock and be worked at from all sides and all angles without the necessity of reaching into the containers. Other trade-offs which Dr. Knasel will discuss deal with the precision and speed about which you can move with an articulated crane as opposed to current shooting boom technology. We must shoot for very high load cycle times to achieve that rapid turnaround rate that we want for corps transportation assets. We are in the process now with MERADCOM and DACS, Savannah of working slip sheet technology into the PALS program. This is an excellent example of the type of system integration work that has to be done throughout the ammunition community to take a much more global look at some of the operations we're developing either in weapons systems or in handling equipment or even back in CONUS upload that have a major impact on how things are done elsewhere in the system.



Viewgraph #34

And of course there is much to do in the robotics area besides the unloading. We are already gearing up with MERADCOM to begin to look at that packing function because we have some immediate near-term needs in that area as well, particularly if we'll going to begin to think about loading racks for an AFARV. The uploader would really be a turn around of the off loader and we feel that technology will be well in hand. The sorting operations and some of the packing operations appear to be good applications of current technology in the pick and place type of robotics but of course ultimately a militarized mobile version.

FOLLOW-ON ROBOTICS APPLICATIONS FOR BRASS

- **SORTING** — DETECT, ROUTE & DISPATCH AMMO BY TYPE
- **PACKING** — REPACK AMMO FROM SHIPPING PALLETS INTO TACTICAL CONTAINERS
- **UPLOAD** — RAPID UPLOADING OF USER VEHICLES

Viewgraph #35

There is a tremendous need for systems integration. This does not come easy - it has to be done much as we did with development of the BRASS concept by working with the TRADOC community, test bedding, trying things out in the field - we're going to know unit configured loads and all of the impacts it has on the system after we get through working with it in the field this summer.

A good example of the need for the integration appears right here in just this collection of ammunition related issues. If you look down that list there's absolutely nothing that is not affected by the way the ammunition is packed with the possible exception of SAAS 3 & 4.

14

BRASS PROGRAM INTEGRATION POTENTIAL.

- FAASV
- AFARV
- UNIVERSAL PALLET
- LOGMARS
- PALS
- 120MM TANK AMMUNITION PACKAGING
- SAAS LEVELS 3 AND 4
- INTERMODAL SHIPPING AND CONTAINERIZATION
- HEMTT
- CHEMICAL DECONTAMINATION OF ASPS & AMMUNITION
- UNIT BASIC LOADS
- ATP OPERATIONS
- ALOC FOR AMMO
- HELICOPTER REARMING
- CAWS/DSWS

65

Viewgraph #36

No matter what class of combat critical supply you deal with - somewhere along the road you must face these fundamental elements and how they interact. Any objective strategy for combat logistics that surfaces less any one of these elements in its basic make up is either flawed or incomplete. The corollary is also important to note, that any one of these elements can not exist in of or for itself alone - but must be in association with a system.

SUPPLY SYSTEM INTEGRATION ELEMENTS

ELEMENTS

PACKAGING

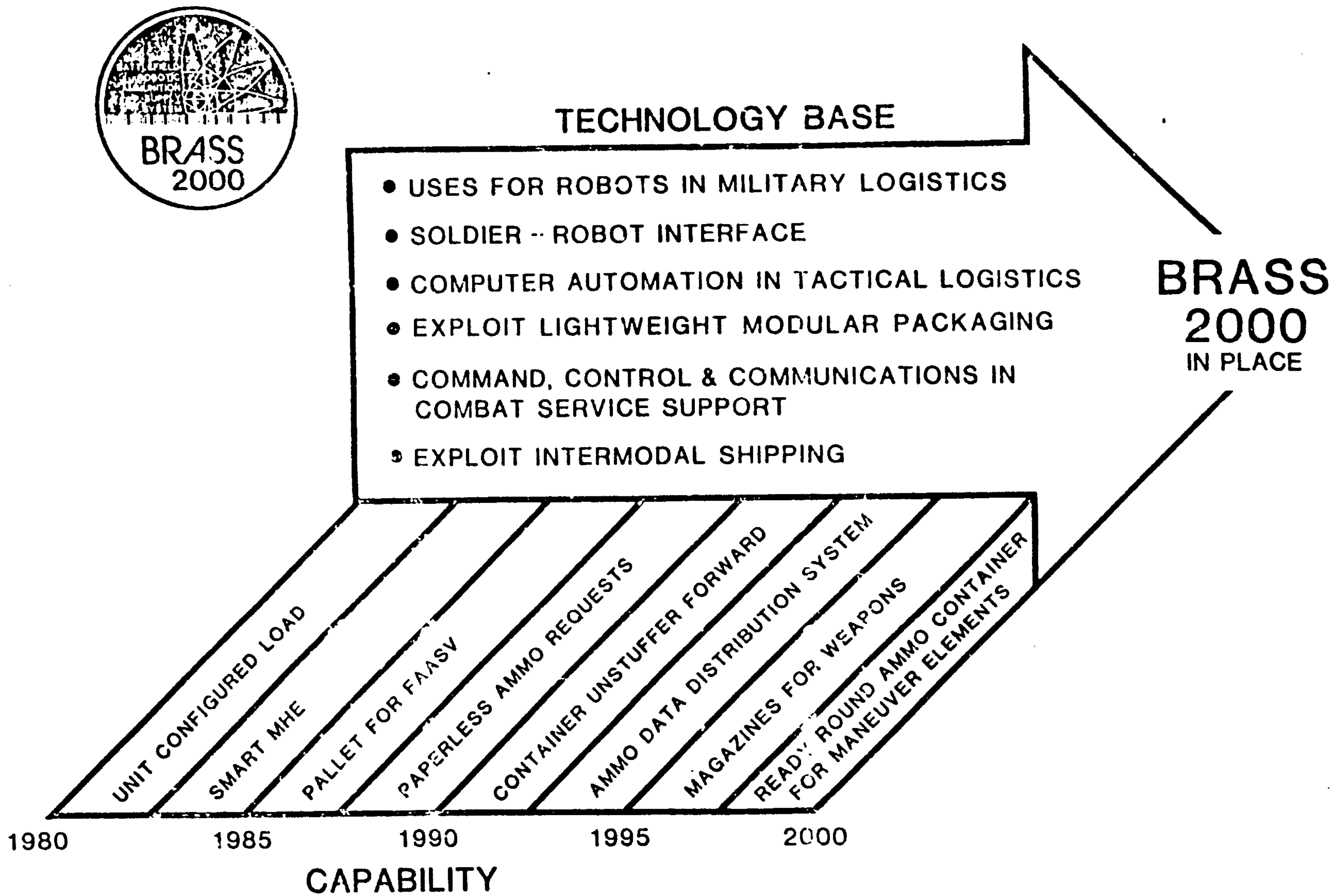
HANDLING

TRANSPORTATION

C^4- COMMAND, CONTROL, COMMUNICATIONS & COMPUTER AUTOMATION

Viewgraph #37

We don't have to wait until the year 2000, we can pick up capability along the way if our technology base efforts are in place, coordinated and all driving toward the same objective goal. And it's on that happy thought that we will end our briefing. Because of the broad scope of the BRASS program I'm sure we've generated more questions than we've answered but we would like to get this message out and understood by industry. Speaking for HEL, for our counterparts in TRADOC, the Missile & Munitions Center & School, and for Mike Davall of Armament Systems Incorporated who will join me now for any discussion you may initiate, it is our hope that industry will examine these issues and help us develop and ultimately achieve a sound objective strategy for ammunition resupply 2000 and beyond - that's what BRASS is all about.



BRASS 2000
TECHNOLOGY BASE
• USES FOR ROBOTS IN MILITARY LOGISTICS
• SOLDIER -- ROBOT INTERFACE
• COMPUTER AUTOMATION IN TACTICAL LOGISTICS
• EXPLOIT LIGHTWEIGHT MODULAR PACKAGING
• COMMAND, CONTROL & COMMUNICATIONS IN COMBAT SERVICE SUPPORT
• EXPLOIT INTERMODAL SHIPPING
BRASS 2000 IN PLACE
UNIT CONFIGURED LOAD
SMART MHE
PALLET FOR FAASV
PAPERLESS AMMO REQUESTS
CONTAINER UNSTUFFER FORWARD
AMMO DATA DISTRIBUTION SYSTEM
MAGAZINES FOR WEAPONS
READY ROUND AMMO CONTAINER FOR MANEUVER ELEMENTS
1980
1985
1990
1995
2000
CAPABILITY

ROBOTICS FOR MILITARY LOGISTICS SUPPORT
- OUTLINE -

- FUNDAMENTALS OF MILITARY ROBOTIC APPLICATIONS
- DEGREES OF ROBOTIZATION
- MAN-ROBOT INTEGRATION (THE GAP IN INDUSTRIAL ROBOT DEVELOPMENT)
- MILITARY LOGISTIC ROBOTIC OPPORTUNITIES

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DEFINITIONS

ROBOT

"A REPROGRAMMABLE MULTIFUNCTIONAL MANIPULATOR DESIGNED TO MOVE MATERIAL, PARTS, TOOLS, OR SPECIALIZED DEVICES THROUGH VARIABLE PROGRAMMED MOTION FOR THE PERFORMANCE OF A VARIETY OF TASKS." (ROBOT INSTITUTE OF AMERICA)

ROBOTIC

INVOLVES SOME OR ALL OF THE ELEMENTS OF A ROBOT, INCLUDING USE OF SENSORS AND INTERPRETATION OR PROCESSING OF THE SENSORY SIGNALS AND RESULTANT CONTROL OF A MECHANICAL FUNCTION OR DISPLAY, COORDINATED CONTROL OF MULTIPLE FUNCTIONS, AND AUTOMATED EQUIPMENT NOT FULLY MEETING THE DEFINITION OF "ROBOT".

BASIC CAPABILITIES OF ROBOTS/ROBOTIC EQUIPMENT

- SENSING AND INTERPRETING SENSORY DATA
  - SENSING AND VIEWING
  - COMPARING AND RELATING
  - TRIGGERING ACTIONS
  - ACCEPTING PROGRAMS AND CONDITIONAL ORDERS
  - DISPLAYING CONDITIONS
- THINKING AND COMMUNICATING
  - DECISION MAKING AND PROGRAM/SUB-PROGRAM/BRANCH SELECTION
  - DIRECTING AND COORDINATING EQUIPMENT/HUMAN OPERATIONS
  - REPORTING AND COMMUNICATING
  - PREPARING OWN PROGRAM
  - GUIDING HUMAN PROGRAMING
- DOING
  - MANIPULATING
  - OPERATING TOOLS AND SENSORS
  - SERVICING
  - EXAMINING AND TESTING
  - DIRECTING MANUAL OPERATIONS

DEGREE OF ROBOTIC UPGRADE

I. MAXIMIZE EQUIPMENT WORK EFFORT

II. IMPROVE PRECISION OF MANUAL OPERATION

III. EXTEND HUMAN SENSES

IV. EXTEND HUMAN PHYSICAL CAPABILITY

V. EXTEND HUMAN CONTROL TO REMOTE OPERATIONS

VI. FOLLOW HUMAN CONTROL AT EQUIPMENT OPTIMUM

VII. SHARE PART OF WORK CYCLE

VIII. PERFORM REPETITIVE WORK CYCLES AUTOMATICALLY

IX. SELECT AND PERFORM ALTERNATIVE WORK CYCLES AND SUB-CYCLES AUTOMATICALLY

X. PREPARE AND FOLLOW PROGRAM AUTOMATICALLY

CHARACTERISTICS OF PRACTICAL ROBOTIC APPLICATIONS

WORK CYCLE	NATURE OF ROBOTIZATION	ILLUSTRATIVE APPLICATIONS
FULL MANUAL CONTROL, EXCEPTIONAL SENSING REQUIRED	SENSOR AND VISION INPUT	BUTTONED-UP OPERATION, LIMITED OPERATOR VISION
PARTIAL SENSOR-GOVERNED CONTROL	SENSORS, PROCESSING, AND LIMITED EQUIPMENT CONTROL	INCREASING PRECISION, MAXIMIZING EQUIPMENT WORK OUTPUT
NOT FULLY REPETITIVE	SENSORS, "MANIPULATOR", PROCESSING, PROGRAMING, CONTROLLING	SHARED MANUAL/ROBOTIC WORK CYCLE TO MAXIMIZE EQUIPMENT OUTPUT
HIGH VOLUME OF LIMITED MIX, SERIES OF REPETITIVE TASKS	AS ABOVE, PLUS CYCLE TRIGGER AND DATA LINKS	INDEPENDENT ROBOT, SPRAYING, WELDING, PICK AND PLACE
HIGH VOLUME OF LIMITED MIX, INTENSIVE PROCESSING OF EACH ITEM	AS ABOVE, PLUS ADDITIONAL NC EQUIPMENT/MACHINES UNDER CENTRAL CONTROL	FLEXIBLE MACHINING CENTERS
SEMI-REPETITIVE TASKS WITH NOT FULLY ROBOTIC EQUIPMENT	FULLY ROBOTIC EXCEPT DISPLAY FOR DIRECTING MANUAL EQUIPMENT CONTROL	MASKED CRANE OPERATIONS, CONSTRUCTION EQUIPMENT, GUN SIGHTS

PRINCIPAL BASES FOR MILITARY ROBOTIC DEVELOPMENTS

BASIS	ILLUSTRATIONS
A. COMPETITIVE WEAPON SYSTEMS	RPV FIRING SYSTEMS CRUISE MISSILE
B. COMBAT SUPPORT	AMMO AND FUEL SUPPLY ROBOTIC MINE CLEARING
C. PROTECT PERSONNEL FROM HAZARDOUS ENVIRONMENTS	REMOTE E.O.D. NBC MONITORING/DECONTAMINATION EXTERNAL SENSORS/SUBPROGRAMS
D. MAXIMIZE PRODUCTION FROM MANPOWER AND EQUIPMENT	REPETITIVE LOGISTIC FUNCTIONS MATERIAL HANDLING MATERIAL PROCESSING
E. IMPROVE READINESS	TRAINERS INDUSTRIAL TASKS DEPOT OPERATIONS

RS14/B8

SUBJECTIVE EVALUATION FACTORS AND CONSIDERATIONS FOR DEVELOPING CANDIDATE ROBOTICIZATION EFORTS

- o MILITARY ROLE
  - HIGHEST VISIBILITY WITH BATTLEFIELD PROXIMITY
  - RANGE OF ROLES
- o DEGREE OF ROBOTIZATION
  - RANGE OF DEGREES
  - DIVERSITY IN NATURE OF ROBOTIZATION
- o STATE OF ART
  - WITHIN COMMERCIAL TECHNOLOGY
  - USE OF COMMERCIAL COMPONENTS FOR DEMONSTRATION
- o TEST BED VALUE
  - ADVANCED SENSORS/VISION AND SENSORY DATA INTERPRETATION
  - OPERATOR SKILL LEVELS
  - FIELD DEGRADATION, MAINTENANCE AND REPAIR

EXAMPLES OF ARMY ARTIFICIAL INTELLIGENCE/ROBOTICS PROGRAMS

(UNFUNDED PROGRAMS IN BRACKETS)

NEAR-TERM	MID-TERM	FAR-TERM
INTELLIGENT MINES	NBC AERIAL RECON	COUNTERMINE VEH
CHEMICAL RPV	ROBOT SPT FOR ASP	FWD AMMO HANDLING
AUTO-LOADER	SMART EOD ROBOT	CONTAINER HANDLING
REFUELING SYSTEMS	RAPID EXCAVATOR	AUTO ASP
TANK FIRE CONTROL	DEMO M110 LOADER	AIRBORNE MINE DET
(INTELLIGENCE DATA BASE)	IMAGE PROCESSING	BIOLOGICAL SENSORS
(ROBOTIC SMOKE GEN)	(PASSIVE SURVEILLANCE)	(IDENT FRIEND/FOE)
	(AUTO SMALL ARMS MNT)	(AUTO AIR DEFENSE)
	(TANK ENG. REPL)	(FIRE-FIGHTING)
		(AUTO LOAD IN NBC)
		(MEDEVAC)

NOT A COMPLETE LIST

RS14/B2

APPLICATIONS OF ROBOTICS/SMART MACHINE TECHNOLOGY TO AMMUNITION HANDLING

OBJECTIVE: APPLY ROBOTIC/SMART MACHINE TECHNOLOGY TOWARD FEASIBILITY ASSESSMENT AND NEAR-TERM DEMONSTRATION OF A ROBOTIC/ AUTOMATED AMMUNITION ISSUE MODULE (AIM), PART OF THE BATTLEFIELD ROBOTIC AMMUNITION SUPPLY SYSTEM (BRASS-2000).

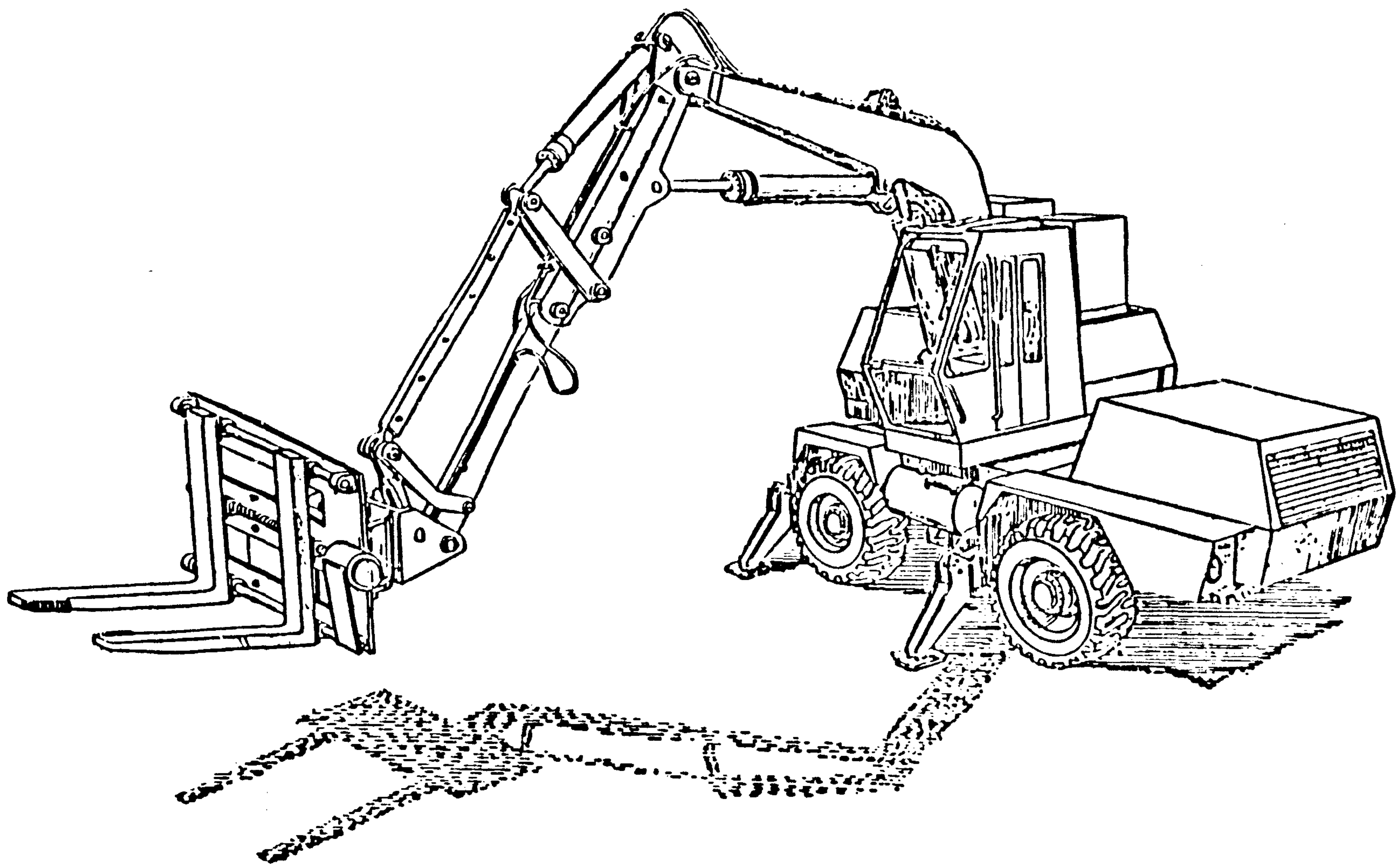
APPROACH:

1. FUNCTIONS TO BE PERFORMED IN AIM MODULES
2. CLOSEST INDUSTRIAL OPERATIONS AND COMMERCIALLY AVAILABLE EQUIPMENT/TECHNOLOGIES
3. CONCEPTUAL DESIGN OF ROBOTIC/AUTOMATED AIM UNITS
4. PRELIMINARY DESIGN OF ONE DEMONSTRATOR ROBOTIC UNIT
5. PROGRAM PLAN AND SCHEDULE LEADING TO DEMONSTRATION OF SELECTED UNIT

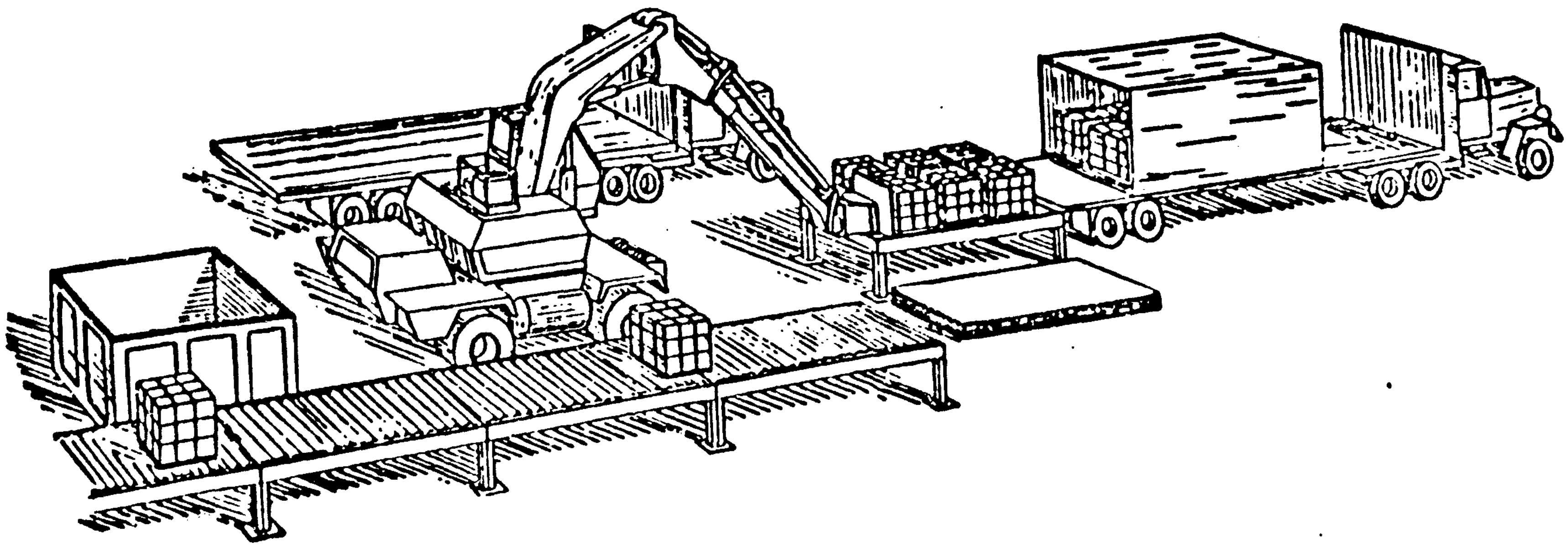
ROBOTIC PALLET LOADER

- <u>CUSTOMER</u>: ARMY HUMAN ENGINEERING LABORATORY
  ARMY MOBILITY EQUIPMENT R&D LABORATORIES
- <u>KEY TECHNICAL CHALLENGES</u>:
  - CONVERT COMMERCIAL EXCAVATOR INTO PALLET HANDLING PRECISION ROBOT
  - MAN-ROBOT INTEGRATION
    - - PRACTICAL PROGRAMMING
    - - ROBOTIC-ENHANCED MANUAL OPERATION
  - SENSOR - ENCODER - ROBOT INTEGRATION
  - PROGRAMMER - CONTROLLER ALGORITHMS
  - INTEGRATION IN (SAI CONCEPTUALLY DESIGNED) AUTOMATED SUPPLY POINT
- <u>SAI ACCOMPLISHMENTS</u> (PROJECT IN PROGRESS)
  - CONCEPT, CONCEPTUAL DESIGN, PRELIMINARY ENGINEERING
  - FULL-SCALE DEMONSTRATOR PRELIMINARY DESIGN
  - DEVELOPMENT AND TEST PLAN AND SCHEDULE
  - INITIATION OF DESIGN AND SPECIFICATIONS

ILLUSTRATIVE ROBOTIC PALLET LOADER DEMONSTRATOR



POTENTIAL UNLOADING DEMONSTRATION
OF ROBOTIC PALLET LOADER



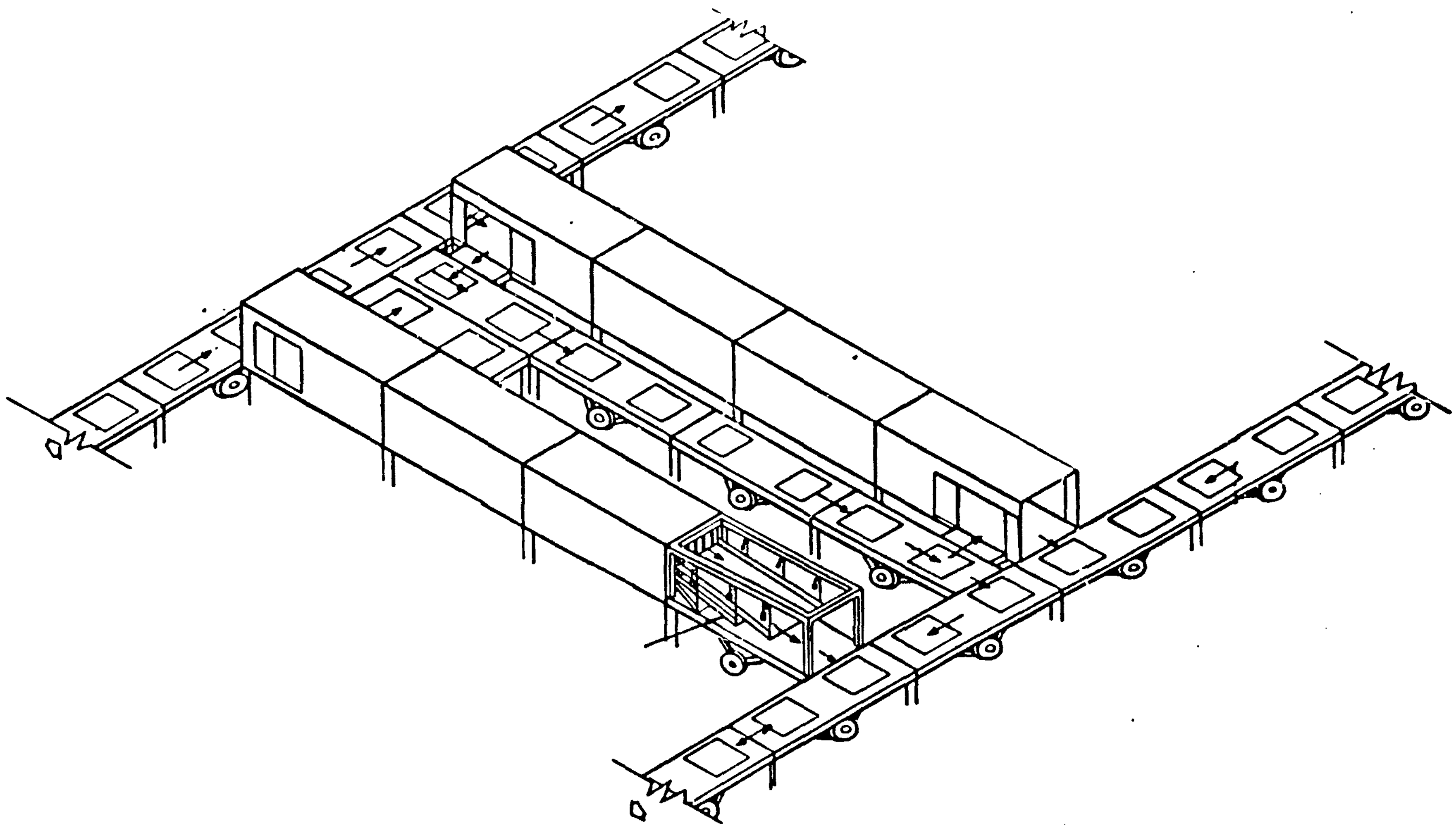
ITEM HANDLING ROBOT UNIT

- **CUSTOMER:** ARMY HUMAN ENGINEERING LABORATORY
  ARMY MOBILITY EQUIPMENT R&D LABORATORY

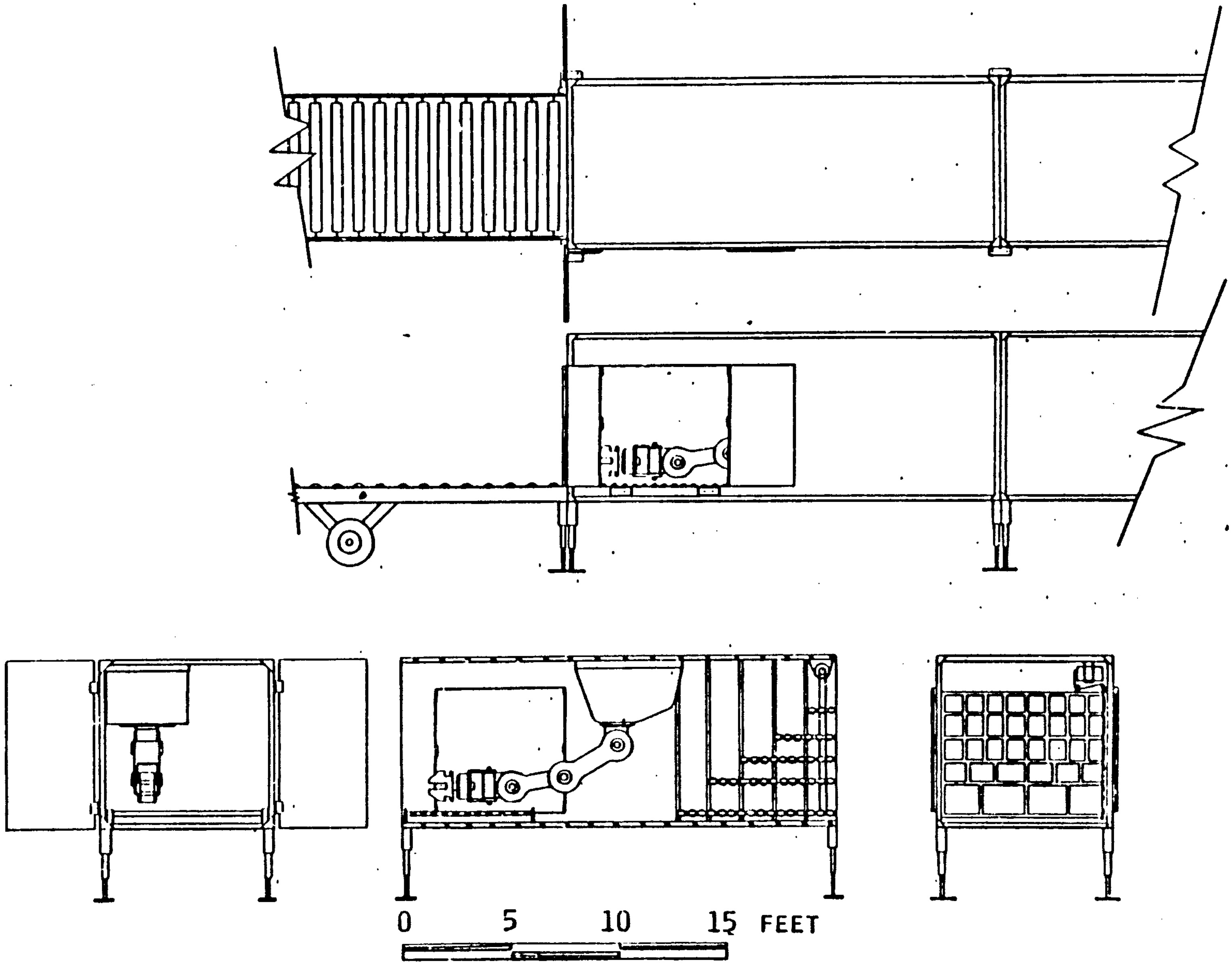
- **KEY TECHNICAL CHALLENGES:**
  - DEPALLETIZE, STORE, AND REPACK ARMY DIVISIONAL AMMUNITION TYPES
  - INTEGRATION IN (SAI CONCEPTUALLY DESIGNED) AUTOMATED SUPPLY POINT
  - INTEGRATION OF MULTIPLE COMMERCIAL TECHNOLOGIES
  - COORDINATION OF MULTIPLE MANIPULATING MEANS

- **SAI ACCOMPLISHMENTS** (PROJECT IN PROGRESS)
  - CONCEPT
  - CONCEPTUAL DESIGN
  - IDENTIFICATION OF COMMERCIAL TECHNOLOGIES
  - INITIATION OF PRELIMINARY ENGINEERING

PACK MODULE PERSPECTIVE



ITEM HANDLING ROBOT UNIT



ROBOTIC REFUELING SYSTEM FOR COMBAT VEHICLES

- <u>CUSTOMER</u>: ARMY MOBILITY EQUIPMENT R&D LABORATORIES
- <u>KEY TECHNICAL CHALLENGES</u>:
  - MAN-ROBOTICS + SENSOR INTEGRATION
  - MECHANICAL - HYDRAULIC - VEHICLE - POWER SYSTEM INTEGRATION
  - SELECTION OF OPERATIONAL PARAMETERS
- <u>SAI ACCOMPLISHMENTS</u> (PROJECT IN PROGRESS, NEW)
  - OPERATIONAL CONCEPTS
  - PRELIMINARY SYSTEM PARAMETERS

MAN-ROBOT INTEGRATION

FUNCTION	MAN	ROBOT
SENSING	1. OBSERVE WORK OBJECT/NATURE. SELECT PROGRAM	2. FOLLOW PROGRAM
	1. IDENTIFY ANOMALIES, INSERT DATA, HALT, OR SELECT ALTERNATIVE PROGRAM/SUBPROGRAM	2. FOLLOW DIRECTIONS. SELECT AND FOLLOW SUBPROGRAM
	2. INTERPRET AND REACT TO ROBOTIC SENSORY INPUT	1. SENSE AND/OR VIEW. DISPLAY FOR HUMAN
	2. RESPOND TO ROBOTIC DIRECTION	1. SENSE AND/OR VIEW. INTERPRET AND DIRECT HUMAN ACTION
		3. REDIRECT BASED ON POSITION FEEDBACK

MAN-ROBOT INTEGRATION

FUNCTION	MAN	ROBOT
OPERATING	DIRECT AND CONTROL EQUIPMENT	ENHANCE MANUAL CONTROL (EG. TOOL COORDINATES. SELECT PATH AND SPEED)
	SHARE WORK CYCLE: PERFORM NON REPETITIVE, UNIQUE OR NOT EFFECTIVELY PROGRAMED TASKS. TRIGGER ROBOTIC CYCLE OR SUBPROGRAMS	SHARE WORK CYCLE: PERFORM REPETITIVE OR EFFECTIVELY PROGRAMED TASKS OR SUBPROGRAMS ON CALL
	CONTROL EQUIPMENT UNDER ROBOTIC DIRECTION	DIRECT OPERATION BASED ON SENSORY INPUT (HUMAN OR ROBOT SOURCE)
	PERFORM TESTS, MAKE OBSERVATIONS, RECCRD RESULTS, ETC. UNDER ROBOTIC DIRECTION	POSSIBLY PERFORM SUBPROGRAM AND PROVIDE ROBOTIC ENHANCEMENT

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MAN-ROBOT INTEGRATION

FUNCTION	MAN	ROBOT
PROGRAMING	1. OFF-LINE PROGRAMING	2. STORE
	1. TEACH	2. CONVERT MOTIONS TO PLAYBACK PROGRAM
	1. TEACH	2. PROGRAM FOR OPTIMUM OPERATION BETWEEN POINTS
	1. INSERT TASK PARAMETERS	2. WRITE PROGRAM BASED ON PROGRAMING INSTRUCTIONS AND PARAMETERS
	2. PROGRAM/TEACH (ON OR OFF LINE)	1. GUIDE HUMAN THROUGH PROGRAMING OPERATION (PER SOFTWARE)
		3. STORE/CONVERT MOTIONS TO PROGRAM

HEL-MERADCOM-SAI

CURRENT MAN-ROBOT INTEGRATION EFFORTS

- OPTIMUM MANUAL CONTROLS AND INPUT TO CONTROLLER/PROGRAMER AND FOR DIRECT EQUIPMENT CONTROL
  - MULTI-DEGREE OF FREEDOM JOYSTICKS
  - ANALOG AND DIGITAL INPUTS
  - SKILL AND TRAINING REQUIREMENTS
  - OPERATION OF DEGRADED SYSTEM
- DISPLAY OF SENSORY/VISION (PROCESSED) OUTPUT OR DIRECTIONS
  - EQUIPMENT/WORK OBJECT POSITIONS/CONDITIONS
  - PROGRAMING LEAD-THROUGH GUIDANCE
  - INTERACTIVE GRAPHICS
- ALGORITHM DEVELOPMENT
  - PROGRAMING PLANNING
  - CONTROLLER SOPHISTICATION/SELECTION

POTENTIAL FURTHER/BONUS TESTING/DEMONSTRATION OF D-RPL INHERENT CAPABILITIES

- CORPS, THEATER, LOGCOM NON-AMMO PALLET LOADING, AND UNLOADING TASKS (BEACH, DOCK, SUPPLY POINTS, RAILHEAD, ETC.)
- POL DRUM LOADING AND UNLOADING
- (WITH TINE-HELD SCOOP) LOADING OF DRY BULK MATERIAL (E.G. CONCRETE BATCH PLANT AGGREGATE LOADING AND CEMENT PALLET FEED, POSSIBLY WITH DEPALLETIZING AND DEBAGGING: ASPHALT PLANT AGGREGATE FEEDING, DRUM HANDLING, AND DE-DRUMMING)
- (WITH SPECIAL HOSE AND TINE-HELD NOZZLE) BULK POL TANK TRAILER/TRUCK/CAR EMPTYING AND FILLING, WITH AUTOMATIC PUMP AND VALVE CONTROL
- PANEL/TRUSS BRIDGE ASSEMBLY SUPPORT
- CONCRETE PLACEMENT/FINISHING OPERATIONS (WITH SPECIAL TINE HELD AND RELEASE-CONTROLLED BUCKET, TINE-HELD SCREED, AND TINE-HELD FINISHER)
- CONUS DEPOT AND GOGO/GOCO INDUSTRIAL OPERATIONS

POTENTIAL FURTHER TESTING OF D-RPL AS
ARMY HEAVY MOBILE ROBOT TEST BED

- o ALTERNATIVE END EFFECTORS
  - BACK HOE: EXCAVATION/LOADING
  - BUCKET LOADER: MATERIAL LOADING
  - CUTTER HEAD AND SUCTION HOSE: DREDGING TO 15 - 20 FEET
  - LARGE DIAMETER EARTH AUGER: SUBSURFACE AMMO/POL STORAGE
  - SMALL DIAMETER AUGERS AND CHARGE HANDLERS
    - -- CRATERING CHARGE PLACEMENT
    - -- QUARRYING
  - FIRE FIGHTING AND DEBRIS REMOVAL
- o ALTERNATIVE TELESCOPING BOOM (W/FORKLIFT)
  - MILVAN LOADING AND UNLOADING
  - CARGO HELICOPTER LOADING AND UNLOADING
- o COORDINATION WITH SUPPORTING EQUIPMENT, E.G:
  - STANDARD MILITARY CONVEYORS
  - RPL ROBOTIC OPERATION OF PUMPS AND VALVES
  - BAGGED BULK MATERIAL DEPALLETIZING-DEBAGGING FRAME (EG. CEMENT)
  - PORTABLE ROBOTIC TOOL/WELDER POSITIONING, SUPPORT, AND OPERATION (EG. STEEL TANK ASSEMBLY)
- o SPECIAL BOOM AND END EFFECTOR
  - RAIL CAR LOADING AND UNLOADING

RS14/B15

POTENTIAL FURTHER TESTING OF D-RPL AS

ARMY HEAVY MOBILE ROBOT TEST BED

- o APPLICATIONS/VALUE/PROBLEMS OF NEW SENSORS
  - VISION EQUIPMENT
    - -- IDENTIFY PALLET POSITIONS FOR AUTO-PROGRAMMING
    - -- PARAMETERIZE RECEIVING BED FOR AUTO-PROGRAMMING
  - PROXIMITY SENSORS
    - -- SAFETY
    - -- CLOSING SPEED CONTROL
    - -- CLOSING POSITION ADJUSTMENT
  - SPECIAL SENSORS
    - -- GYRO FOR HIGH SPEED MOVEMENT
    - -- STRAIN GAUGE LOAD/SPEED CONTROL
- o CARRIAGE MODIFICATIONS, EG.
  - SEPARATE ELECTRIC HYDRAULIC PUMP FOR INSIDE FIXED POSITION OPERATIONS
  - ROBOTICALLY DRIVEN RAIL WHEELS FOR EXTERIOR AS/RS OPERATION (WITH TOWED FLAT CAR AND POSITION SENSORS)
  - MARINE MOUNTS: LST, LIGHTER, BARGE, PIER
- o INTEGRATION OF REMOTE HUMAN GENERAL CONTROL WITH ROBOTIC SUBPROGRAMS
  - SUPPLY HANDLING IN NBC ENVIRONMENTS
  - (SPECIAL END EFFECTORS) DECONTAMINATION, EOD, FIRE FIGHTING, ETC.

ILLUSTRATIVE FURTHER TESTING OF D-RPL AS

DOD HEAVY MOBILE ROBOT TEST BED

o ALTERNATIVE END EFFECTORS
  - AIRCRAFT BOMB AND MISSILE LIFT AND LOADING
  - BOMB HANDLING, AUTOMATED BOMB ASSEMBLY SUPPORT

o REMOTE CONTROL AND ROBOTIC SUBPROGRAMS
  - UNEXPLODED ORDNANCE HANDLING AND DISPOSAL
  - OPERATIONS IN NBC CONTAMINATION
    -- SUPPLY HANDLING
    -- AIR STRIP REPAIR (SPECIAL END EFFECTOR)
    -- DECONTAMINATION (SPECIAL END EFFECTOR AND SUPPORT TRAILER)
  - FIRE FIGHTING AND DEBRIS REMOVAL/CLEARANCE

o SPECIAL BOOM/END EFFECTORS/RAIL WHEELS/SUPPORT TRAILERS
  - FACTORY, YARD, AND DUMP FIRE FIGHTING/DAMAGE LIMITATION
  - RAIL CAR LOADING AND UNLOADING
  - SHIP PALLET LOADING AND UNLOADING

ILLUSTRATIVE MILITARY LOGISTIC SUPPORT ROBOTIC OPPORTUNITIES

- o MAN-ROBOT CRANE (ESPECIALLY WITH "SMART" SPREADER BARS)
  - ROBOTIC VISION/SENSORS, GUIDANCE TO MANUAL OPERATION, REMOTE SPREADER BAR OPERATION
  - ON/OFF SHIP, BARGE, RAILCAR, TRAILER, ETC.
  - SUPPLEMENTAL KIT FOR CURRENT CRANES AND CONTAINER HANDLING TRUCKS

- o MILVAN-MOUNTED AUTOMATED STORAGE/INVENTORYING/RETRIEVAL SYSTEM
  - AUTOMATED SMALL PARTS STORAGE, ISSUE, REORDER
  - COMMERCIAL AS/RS AND COUNT-BY-WEIGHT TECHNOLOGIES AND EQUIPMENT IN MILVAN MODULES

- o GROUNDED PALLET FIELD AS/RS
  - ROBOTIC PALLET HANDLING VEHICLES
  - POSITION REFERENCE SYSTEM
  - CENTRAL SUPPLY OPERATION CONTROL

- o ROBOTICALLY TRACKING SEMI-TRAILER TO WAGON CONVERSION BOGIES
  - ROBOTICALLY TRACK TRACTOR TREAD
  - TRACTOR DRAWN MULTIPLE TRAILER TRAINS ON RESTRICTED ROUTES

Ralph L. Day

United Parcel Service

Thank you for the opportunity to speak to you concerning package testing, as we in the small parcel field view it. In this seminar, we have seen many presentations on relatively high technology testing techniques. There is a big difference though, in the kinds of testing that goes on in the real world of a small parcel carrier, and in the objective of the carrier for doing testing. From the carrier's point of view, packaged product performance testing is done not only to protect the merchandise shipped but also the carrier's personnel, and reputation for good service.

First of all, the transportation environment that is involved with small parcel shipping is quite different from that of conventional motor freight, that is, the typical common carrier truck line. Yet, in my particular company, virtually all forms of transportation are used. We can expect packages to move by road, by rail, by air - and yes - when you consider the import trades, they may even move as non-containerized merchandise by boat.

In the case of conventional motor freight, packages are often in multiples, palletized, and may be "sorted" only by being moved from one trailer to another, across a dock. You can imagine the cost of delivering parcels using that kind of sorting system. It would be astronomical and it would be slow. Clearly the loading dock, fork lift operations so necessary to motor freight are just not applicable to parcel delivery systems.

The answer is conveyor belts and slides that can move large numbers of parcels past sorters and into vehicles. The result is very fast dependable service at rates for individual shipments that can't be compared to the motor freight industry. This speed and low cost depend on a number of factors: For the carrier - training, handling, supervision, equipment; For the shipper - packaging of individual shipments in a different fashion from motor freight.

The small parcel field is already relatively sophisticated in handling systems, and more progress is being made. Computer technology is rapidly influencing the design of sortation techniques, providing increased sort capacities at faster rates and at lower costs. One example is voice encoding.

In voice encoding, the sorter wears a headset microphone, into which he speaks the destination ZIP code of the package he is sorting. The computer remembers the position of that package on a belt, and when the package reaches an appropriate point on the belt system, a pusher arm moves the package from the belt onto a take away slide, which delivers the package to its destination vehicle.

We also must consider what the actual loads look like in a small parcel trailer. In contrast with conventional motor freight, which very often has multiples of the same size and shape package - perhaps on pallets - the small parcel field generally has a load in which all packages are different. We try to fit these packages into a cost saving technique that we refer to as brick loading. By this is meant, that the packages will be fitted into every available slot, resulting in random forces on the surfaces of packages in any orientation. The packaging engineer then, must be well aware that there is no such thing as a guarantee of "this side up" or "top load only." Cautionary markings are no substitute for adequate packaging. We do try to handle packages so that the labels are "up" on the belts - we need this, in order to read the labels - but there is certainly no guarantee of orientation once a package is sorted into a trailer. But, label placement does influence handling, and should be considered. The basic message, however, is that a package must be able to withstand all of the environmental effects from any direction.

How does a packaging engineer consider the options of design for the small parcel field? There are perhaps three ways. The first two we will touch briefly, one because it is well covered technically at these sessions and the other because the subject is infinite, and needs specific treatment. The remaining one, we'll dig into - as it may provide you with some useful ideas. The first, is FORMAL TESTING.

Years ago, my company used to consider adequacy of packaging as something that was simply a "judgement call" on the part of the carrier. If our representative said that your packaging was insufficient - well, that was that. But by what definition, by what standard? It seems that there has "always" been a National Motor Freight Classification, "always" a Uniform Freight Classification with all of the numbered packages that had to be met if your packaging was to be considered adequate. Yet, UPS and Parcel Post are not participants in those tariffs. What applied to them? About twenty years ago, UPS began to consider the options. We were not a truck line, and our handling is quite different than a truck line, so the suggested truck packaging was not the way to go. We were pioneering the way. In those days, the only published performance standard was that published by the National Safe Transit Committee of the Porcelain Enamel Institute. Later, the NSTC became independent, and is now known as the National Safe Transit Association, in which form it exists today as a voluntary, consensus, standards writing organization based in Chicago. UPS adopts NSTA 1-A as a part of the Rules tariff which we publish. This determines the basic, or minimum standard that a packaged product must meet for acceptance by UPS. Of course, many packaged products need to meet

higher standards to ensure transit success. NSTA requires only a vibration test, followed by a drop test series, with an optional compression test. There had to be something more. That "something" has now come along in the form of the American Society for Testing and Materials 1982 published D-4169 Performance Standard, which permits the refinement a packaging engineer needs to more precisely protect merchandise moving in any one of 14 specified "cycles."

The second classification of testing that might be considered, is what is referred to at UPS as "ENVIRONMENTAL TESTING." Let me hasten to say, that this has absolutely nothing to do with the Environmental Protection Agency, and all that recent uproar. What we mean, is what is actually happening to the package as it moves in the system. Sometimes the best formal testing won't identify some little package characteristic that causes failure when the packaged product moves in the actual environment. A more common term would be: Test Shipping. The environment is the whole picture - the belts and slides we saw before, the actual driver in pickup or delivery, or the condition encountered in rail or air movements. Test shipping for UPS, means nothing more than introducing packages into the system, permitting them to ride in the normal way to a destination. This destination may be one of our laboratories where a report can be written as to the conditions upon arrival, or an intermediate destination where the package is relabelled for return or further travel. Many packages shipped as environmental tests, will be instrumented in some way, so that the details of their transit experience can be examined by the packaging engineer later.

If anyone in the audience is interested in environmental type testing, I'd encourage you to speak to me later, as we will be glad to assist you in setting up a program for your needs.

To provide a little variety in this Seminar, I am going to go into the third testing option in a little more detail. COMPARATIVE TESTING is a simplistic approach, which can yield meaningful results. To illustrate this, I am going to show some slides taken at the UPS laboratory at Des Moines, Iowa, one of seven laboratories that my company operates as a service to our customers. Our laboratories are by no means as exotic as some of the research type facilities with which many of you are associated; however, we are equipped to do basic testing. To illustrate, we are going to show some comparative tests run with two types of equipment. We are going to be using a compression tester fixtured for a special application; and first, a S.M.I.T.E. tester. (S.M.I.T.E. stands for Simulator, Mechanical Impact Test Equipment). With an acronym like that, you know it has to have military origins. It does; it was developed by the Naval Testing Laboratory at Warminster, Pennsylvania for Sonobuoy testing.

To give you an illustration of how a SMITE tester can work, let's use these next slides as a simple demonstration. We have placed an empty 200 pound test corrugated carton on the test stand. The vertical lines marked on the carton indicate the flute direction of the corrugated. The blue and red striped bar simulates a package impacting on another package. We show the bar in the flat position, although for some kinds of military testing the bar can be rotated to provide an angle impact. Upon impact, you can see that the vertically oriented carton has essentially resisted damage. In comparison, when a similar carton is turned on its side, i.e., flute direction parallel to the impact, virtual total destruction of the carton and closure occurs. This may be significant because it

illustrates what can happen just by changing placement of labels. Label parallel to flute direction may result in collapse of packaging in a load environment. Remember: Place labels perpendicular to flute direction for best results. That's enough for the preliminary. Now let's work through some actual comparisons.

One type of package which does not ride well in our type of system, is the long, thin type of pack. Examples could be fishing rods, antennas, curtain rods, etc. For these types of difficult packages, we have special "incompatible" procedures, where special handling is provided in our Hubs and Centers. We take extra care with them, but we can't provide special handling 100% of the time. We need your design help to supplement these packaging problems. Our illustration, is a simple corrugated tube. We will give it a Bridge Test. A half-round steel bar is placed on the SMITE tester platform. This gives one end of the package a three inch elevation. The SMITE tester bar is allowed to fall on the package from a height of three inches. In this case, the corrugated triangular tube has failed and buckled. In the comparison, we have placed a chipboard tube in the corrugated triangle, and the assembly "passes" the SMITE bridge test, and does not buckle on impact. Such an impact simulates the effects that can occur when these long packages ride with other types of merchandise on curving conveyors.

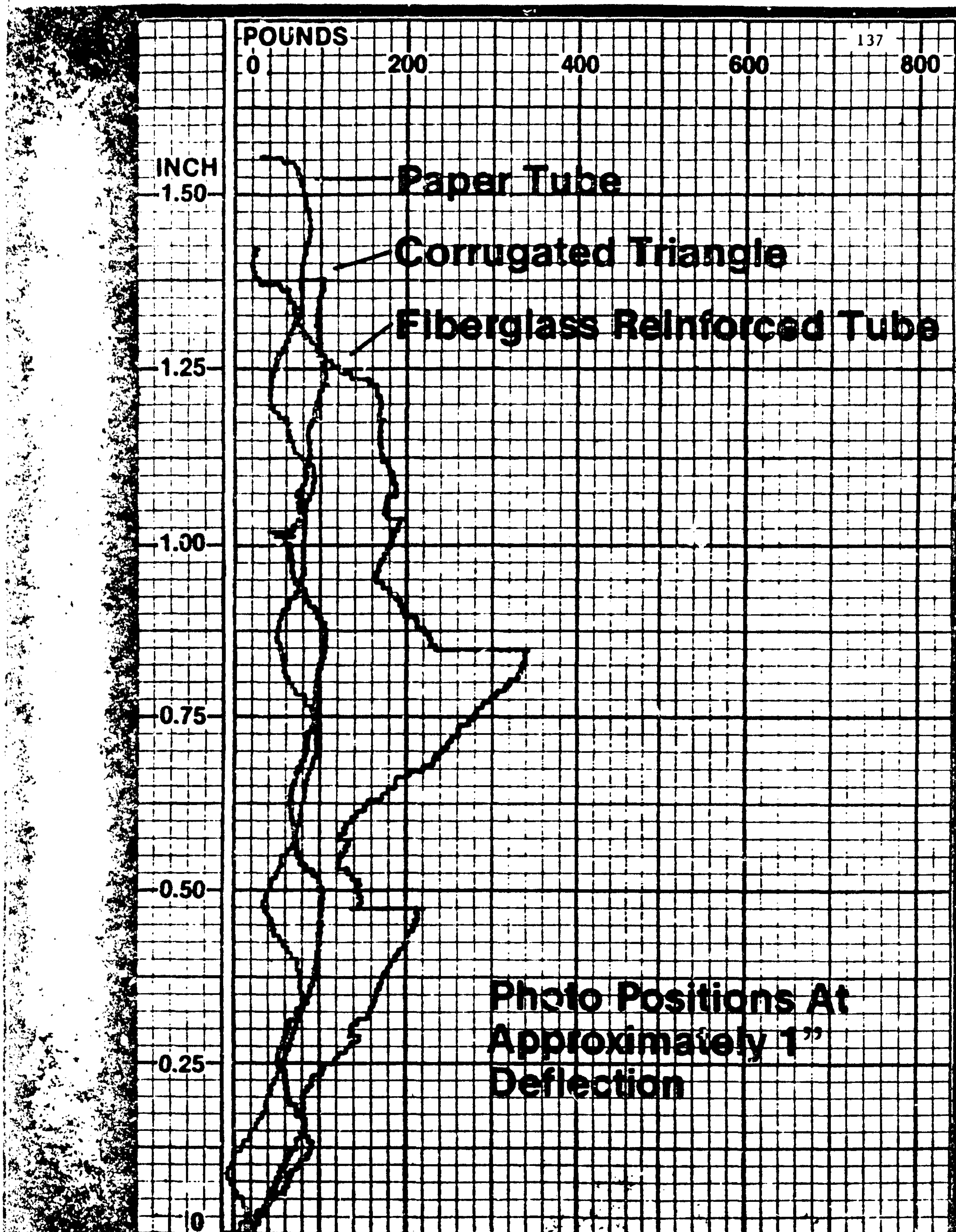
Now let's look at a Compression Tester. In this slide, the compression tester is being fixtured so that this same bridging or bending condition can be simulated on a piece of test equipment where actual measurements and effect display can be recorded. Our fixturing is simply three short pieces of wooden 2x4, one at the center of the sample, and one at each end of the sample, at the compression tester's platen edges. When the compression tester operates, the sample is forced to bend in the center. The amount of resistance that the sample gives us, is read on the chart, and is the measure of how well the sample is resisting the bending force. Eventually, the triangular tube fractures, which is considered the failure point. The specifics of the failure can be read from the chart, both in terms of pounds applied, and amount of deflection. A similar test is run on a fiber tube pack. The final example, was a fiberglass reinforced plastic tube. Here, the failure was somewhat unexpected, as the tube failed first by collapse of the structure, not be bending.

The results of these 3 tests can be read on this summary chart. This is the actual graph; as for convenience, all three tests were plotted on the same graph paper.

In conclusion, I'd like to remind you that there are three ways of testing for the shipping environment:

1. Formal Testing
2. Environmental Testing
3. Comparative Testing

Our objective is not just to meet a test, but to be able to provide meaningful recommendations through all kinds of testing, so that we can maintain our fast, dependable, low-cost parcel service. We need your help in packaging to get the job done.


POUNDS
0
200
400
600
800
INCH
1.50
1.25
1.00
0.75
0.50
0.25
0
Paper Tube
Corrugated Triangle
Fiberglass Reinforced Tube
Photo Positions At Approximately 1" Deflection

Ronald R. Hinkle
Hazardous Materials
Systems Manager

UPS
United Parcel Service

51 Weaver Street
Greenwich Office Park 5
Greenwich CT 06830
Phone (203) 622-6008

In the presentation preceding mine, the differences in environments were pointed out between the small parcel field, where we have small individual packages and shipments by freight carriers which are generally in multiples and possibly palletized.

Included in the mix of packages within the small parcel field are packages containing Hazardous Materials. These hazardous packages would have to meet the requirements outlined in the Federal regulations and in addition be packaged to move safely under the different handling conditions of the small parcel field.

It was felt that the Federal requirements did not completely address in its packaging requirements the variation in handling of small parcels. As a result the Guide for Shipping Hazardous Materials was developed.

The guide is not a tariff but was specifically developed to provide information on packaging which would not only meet the D.O.T. requirements but move safely in the small parcel environment.

The guide gives additional information on:

- Preparation of package - marking and labeling
- Preparation of shipping papers
- Additional UPS requirements
- Items which are prohibited by UPS

The heart of the guide, The Hazardous Material Listing pages, is a modified listing of the 172.101 Hazardous Materials Table from CFR 49. In this section, we have addressed only movement by ground. We are not involved with the water mode and although we do have air service, hazardous materials are not permitted.

The Hazardous Material Listing pages have been expanded to list 3200 items as opposed to the 1800-2000 items listed in CFR 49. The additional entries have been taken from various N.O.S. categories and have been specifically listed by name.

Also included in the listing pages are:

- Hazardous Material description
- Proper shipping name
- Hazard class
- Type label required
- Ltd. Qty. exception information
- Maximum unit quantity
- Packaging recommendations

The information required on shipping papers is also highlighted in this section.

Hazardous substance information is also noted for those materials having an "RQ" or Reportable Quantity of 1 or 10 pounds.

The last section or the green pages of the guide is devoted to packages. This section includes the NSTA 1-A pre-shipment test procedures plus illustrations of 41 different packaging selections.

These packaging selections are referenced in the Hazardous Materials Listing Table and include information on:

- Inside container
- Cushioning
- Outside container
- Sealing
- Labeling and Marking

In preparing this guide it has been our aim to present a package which not only meets the requirements of the D.O.T but will be able to move safely in the small parcel environment.

DOD HAZARDOUS MATERIAL, PACKAGING - TRANSPORTATION CERTIFICATION

1983 Briefing
Spring Meeting, ADPA
Packaging, Handling & Transportability Division

D. R. VOLZ
Traffic Manager
AD/YXC Eglin AFB FL

DOD HAZARDOUS MATERIALS PACKAGING CERTIFICATION

INTRODUCTION.

I would like to make a few comments about the efforts taken by the Services to systemize the "Certification of Equivalency" program for DOD hazardous materials packaging. This is a program which provides the procedures for the government to use DOD issued Certifications of Equivalency (COE) for certain hazardous components that would otherwise require an exemption issued by the US Department of Transportation (DOT).

First, we need to define how the term certification is used in this discussion. All shipments of hazardous materials in common carriage that are listed in Title 49, Code of Federal Regulationa (CFR), Table 172.101 require the shipper to attest to the following certification on the shipping document.

VIEWGRAPH 1

SHIPPERS CERTIFICATION
(172.204(a), 49 CFR)

"THIS IS TO CERTIFY THAT THE ABOVE NAMES MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION."

We all know that compliance with 49 CFR in the packaging and transportation of hazardous materials is a matter of Public Law. Section 110 of Public Law 93-633 provides very strong incentives for us to ensure our compliance. Excerpts of these provisions are provided to refresh our memories.

VIEWGRAPH 2

CIVIL PENALTIES

49 CFR

Section 107.343(a)

"A person who knowingly violates a requirement of this subchapter applicable to the transporting of hazardous materials or to the causing of them to be transported or shipped is liable for a civil penalty of not more than $10,000 for each violation. When the violation is a continuing one, each day of the violation constitutes a separate offense."

Section 107.343(b).

"A person who knowingly violates a requirement of this subchapter applicable to the manufacture, fabrication, marking, maintenance, reconditioning, repair or testing of a package or container which is represented, marked, certified or sold by that person for use in the transportation of hazardous materials in commerce is liable for a civil penalty of not more than $10,000."

VIEWGRAPH 3

CRIMINAL PENALTIES

49 CFR, Section 107.371

"Section 110(b) of the Act (49 U.S.C. 1809(b)) provides a criminal penalty of a fine of not more than $25,000 and imprisonment for not more than five years, or both, for any person who willfully violates a provision of the Act or a regulation issued under the Act."

***

The Department of Defense (DOD) has been granted administrative relief in certain instances to depart from the hazardous materials regulations under 49 CFR, Section 173.7(a). The DOT allows DOD to package hazardous materials IAW DOD regulations provided that the packaging is of equal or greater strength and efficiency as required by DOD Regulations. An excerpt of this provision in 49 CFR follows:

VIEWGRAPH 4

49 CFR

Section 173.7(a)

"Shipments of hazardous materials offered by or consigned to the Department of Defense (DOD) of the US Government must be packaged, including limitations of weight IAW the regulations in this subchapter or in containers of equal of greater strength and efficiency as required by DOD regulations. Hazardous materials shipped by DOD under this provision may be reshipped by any shipper to any consignee provided the original packaging has not been damaged or altered in any manner."

Section 173.7(a)(1)

"Hazardous materials sold by the DOD in packagings that are not marked IAW the requirements of this subchapter may be shipped from DOD installations if the DOD certifies in writing that the packagings are equal to or greater in strength and efficiency than the packaging prescribed in this subchapter. The shipper shall obtain such a certification in duplicate for each shipment. He shall give one copy to the originating carrier and retain the other for no less than 1 year."

***

The DOD COE, then, provides the written substantiation to the "Shippers Certification" (172.204) that the packaging is authorized, although it may not be specifically provided for in the hazardous materials regulations, and in most instances replaces the requirement for a DOT Exemption. The DOD COE is the written authority to show compliance, convey information and record configuration.

BACKGROUND.

In 1971, the DOT provided to DOD an interpretation of the intent of 173.7(a). Key to this interpretation were the words "to give as much latitude as possible to the Department of Defense, provided containers are of equal or greater strength and efficiency". (See figure 1) A further interpretation was provided to the USAF in 1971 that generally tells us that packaging, substantiated by test data to ensure it does provide a degree of safety at a level equal to DOD Regulations, should be certified under Section 173.7(a). (See figure 2)

The events of 1974-1975 focalized DOD concerns toward establishing a uniform, standardized approach to be used by the services in establishing DOD Certification of Equaivalency procedures.

- Transportation Safety Act of 1974
- New Exemption Procedures

In July 1977, the Joint Technical Coordinating Group (JTCG) authorized the Hazardous Materials Working Party to draft a joint services regulation. The JTCG/PKG/HM working party was formed to develop and coordinate these procedures. A joint service regulation, DARCOM-R 700-103; NAVMATINST 4030.11; AFSC/AFLC Regulation 800-29; and DLAR 4145.37 was published in November 1979.

This joint procedure basically sets forth the Policies and Procedures for Hazardous Materials Packaging Certification. It provides a standardized method for the services to use in determining the need for and authorizing DOD Certifications of Equivalency.

- Provides for assignment of uniform certification control numbers, i.e. AF-82-52.
- Provides for a DOD Certification of Equivalency vice a DOT Exemption.
- Ensures requirement for data/safety submittal and analysis.
- Provides a focal point for centralized indexing and distribution of Certification Control Numbers.

The intended purpose of the DOT interpretations of 173.7(a) applicability and the joint services regulations are (1) to utilize the 173.7(a) provisions to reduce the number of DOT exemptions being issued to DOD; (2) Provide a management tool to ensure through written policies and procedures that DOD packaging does indeed meet the equal or greater strength and efficiency rule.

MANAGEMENT.

Generally the management of the Certificaiton of Equivalency Program provides the assurance that a disciplined approach to packaging certifications are being taken through compliance with the joint service regulation AFSC 800-29 (et al). Our responsibilities are briefly summarized in this viewgraph:

VIEWGRAPH 5

CONTAINER CERTIFICATION OF EQUIVALENCY

MANAGEMENT REQUIREMENT

- OBTAIN/REVIEW CONTAINER DRAWINGS, TEST REPORTS, 3311/B TECHNICAL DATA
- REVIEW IN DETAIL 49 CFR REQUIREMENTS
- COORDINATE WITH SAFETY OFFICES FOR HAZARD CLASSIFICATION
- DETERMINE/COORDINATE CONTAINER/VEHICLE TEST REQUIREMENTS, REPORTS
- PREPARE DOT EXEMPTION APPLICATION (IF REQUIRED)
- ISSUE CERTIFICATES OF EQUIVALENCY
- MAINTAIN OFFICIAL FILES FOR REVIEW/REVISION/DISTRIBUTION THROUGHOUT DOD

***

The certifying office or activity must concern itself that the packaging certificaiton, and any revisions or re-issues are based on substantiated tests, analysis and data. We cannot expect any less of ourselves than the DOT expects of itself in issuing an exemption. We must address these questions:

THE ITEM IS SAFE TO TRANSPORT --MEANING IT HAS PASSED REQUIRED SAFETY QUALIFICATION TESTING (MIL-STD-882, MIL-R-25535, MIL-STD-1455, MIL-STD-810, TO 11A-1-47, ETC).

THE ITEM IS PACKAGED TO PROTECT IT PHYSICALLY AND ENVIRONMENTALLY -- MEANING CONTAINER QUALIFICAITON TESTING (MIL-STD-648, FTMS 101, MIL-STD-331, ETC).

THE PACKAGING IS SO DESIGNED AND CONSTRUCTED TO PROVIDE A LEVEL OF SAFETY CONSISTENT WITH THE PUBLIC INTEREST TO PROTECT AGAINST RISKS TO LIFE AND PROPERTY WHILE TRANSPORTED IN COMMERCE--MEANING COMPLIANCE WITH 49 CFR (107, 173, 178, ETC).

The Armament Division has achieved safe and efficient packaging of hazardous materials utilizing a standard set of container qualification tests to validate a wide variety of container designs. These basic tests, are listed by example in figure 3. We seldom use the low pressure (altitude) test, method 5000.1 of MIL-STD-810C except for some gaseous or liquid hazardous mat ials packed in containers of questionable design or

of unknown characteristics. Previous testing, using FTMS 101, Method 5009 with 1.5 psig has shown that the same basic results and confidence may be obtained easier and at less cost. Depending on the commodity, most other tests are listed in MIL-STD-648 and MIL-STD-331. We recommend the tests cited in figure 4 as a minimal set of standard tests for hazardous materials requiring a certification of packaging.

In addition to the above container qualification tests, a 48" flat drop is performed on selected hazardous materials packaging of class A & B explosives to validate the capability of the container to retain its contents during repeated mechnical handling in the distribution system. In some instances a 48" or greater drop is mandated by regulatory documents as evident in 49 CFR for type A packaging, 173.398; shipments by Air, 173.6; molded or thermoformed polyethlene packaging, 178.35a; packging for blasting agents, 173.114a, etc. We normally require performance of the 48" drop test as a standard test required on all-up-round (AUR) packaging of missiles, foreign weapons, propulsive state rocket motors, and other items determined by the packaging and certifying office as necessary to validate the packging design.

Management should also be aware of changing requirements whether they are less stringent or more exacting when their responsibilities include hazardous materials packaging and transportation. These changes may come about through DOD letters of interpretation, notices of rule changes, final rule decisions or notices in the Federal Register.

In 1980, DOT encouraged DOD to work closely with DOD contracters to implement 173.7(a) procedures whenever possible to avoid emergency exemption actions. The thrust of this effort was to reduce the increasing amount of DOT exemptions being issued on DOD hazardous materials (figure 5).

In 1982, we requested further interpretation of the applicability of 173.7(a), particularly for our all-up-round missile packaging. The existing provisions were unclear as they pertained to other than subparts dealing with explosives. Also, 173.87 seemed to prohibit the assemblage of components of some of our missile configurations unless they were specifically exempted by DOT. The DOT interpretation provided a rather liberal authority to DOD, expanding the provisions of 173.7(a) to all subparts of Part 173 of 49 CFR. (See figure 6).

Under certain circumstances, transportability testing to develop and validate truck and railcar load and securement procedures are conducted and the approved methods are cited in the certification of equivalency issued. An example of this requirement is the packging certification for 30MM ammunition where approval was contingent upon proven transportation safety provisions being tenant to the Certificate Of Equivalency.

The COE procedures may not be used for all DOD hazardous materials, since Section 173.7(a) is not an all-inclusive delegation of authority by DOT. For example are those hazardous materials requiring specific manufacturing procedures, testing or fabrication; shipments which require a DOT-E-5022 for intransit heating or cooling; or departures from existing DOT rules that are not packaging related i.e. new proper shipping names. Our policy is whenever in doubt, obtain authoritative guidance.

APPLICATION OF COE PROCEDURES.

The utility of a DOD issued COE is brought to light when "short fuze" situations arise or when compressed RDT&E efforts occur. It is not unusual that DOD can issue a COE within 30 days, given sufficient test and safety data and packaging drawings to substantiate its issuance. As many of you are aware, I'm sure, the DOT may have an extensive backlog of exemption requests that would require a substantially greater amount of time to process and approve an exemption application.

The AIM-7 and AIM-9 missile systems are typical examples of complex weapons systems incorporating a variety of hazardous components. These components either separately or combined require either a DOD COE or a DOT Exemption for their legal entry into transportation.

***

VIEWGRAPH 6

(VIEW OF AIM-7F ALL-UP-ROUND)

***

VIEWGRAPH 7

(VIEW OF AIM-9L ALL-UP-ROUND)

***

The movement of some of these components from subcontractors or vendors to the prime contractor for build-up may also require either a DOT Exemption or a DOD COE for their legal movement.

***

These documents then generally comprise the DOD regulations and methodology that the services employ through testing to determine "equal or greater strength and efficiency as required by DOD regulations." Once this determination is made, a "container certification" is accomplished. (See figure 7.)

***

VIEWGRAPH 8

DOD COE AF-82-52

***

I encourage both military and industry representatives to explore the feasibility of using the DOD Cetification of Equivalency procedures during your weapons system management/engineering evaluation reviews. The HQ Military Traffic Management Command, Washington DC (MTMC-SS) publishes an an annual index of DOD COE's and DOT exemptions for military hardware. In this index are the focal points of the services assigned the responsibility for issuing DOD COE's. (See figure 8.)

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

January 13, 1971

File: §173.7(a)

Mr. John F. Hyde
Colonel, MPC
Chief, Office of Safety & Security
Department of the Army
Headquarters
MTMTS
Washington, D.C. 20315

Dear Mr. Hyde:

Please refer to your letter of December 28, 1970, concerning interpretation of the phrase "including limitations of weight" in 49 CFR 173.7(a).

Research into the background covering the development of this regulation specifically indicates that the intent of the rule was to give as much latitude as possible to the Department of Defense, provided containers are "of equal or greater strength and efficiency". The rule requires that weight limitations contained in applicable DOT or DOD packaging regulations are not to be exceeded. This section of the regulations is written in order not to provide a waiver of weight limitation stipulated by the applicable set of regulations being utilized.

In other words, when DOD makes the determination that a packaging for hazardous materials complying with DOD specifications is equal or greater in strength and efficiency than that prescribed by the DOT regulations, the weight of the package is

FIGURE 1.

not restricted to the weight limitations prescribed for the DOT package. This is not to be construed to apply to limitations on the maximum quantity in one outside container shipped by rail express, as set forth in 49 CFR 172.5 and Part 175.

Sincerely,

C. B. Smith
Acting Chairman of
Hazardous Materials Regulations Board

cc: Mr. R. M. Graziano, Director
Bureau of Explosives
Association of American Railroads

Mr. Henry Jones
Munitions Carriers' Conference
American Trucking Association

FIGURE 1.

MTMTS-SSA (15 Sep 71) 1st Ind
SUBJECT: Section 173.7 (a) CFR 49 Air Force Policy

DA, Headquarters, Military Traffic Management and Terminal Service, Washington, D. C. 20315 28 September 1971

TO: Director of Transportation, ATTN: AFSTPM, Department of the Air Force, Washington, D. C. 20330

1. The wording of section 173.7(a) CFR 49 has been interpreted by the Hazardous Materials Regulation Board to mean that if the Department of Defense determines that a proposed packaging, regardless of whether it is of the same material, size, or type as provided in the Hazardous Materials Regulations, is of "equal or greater strength and efficiency", than a container required by the DOT regulations for the hazardous materials to be shipped, then DOD should use 173.7(a) as authority, instead of applying for a special permit. Such a determination must be based on supporting data such as test data, military specifications, packaging orders or drawings required by the Military Department involved.

2. In view of this interpretation by DOT it appears that hazardous materials being shipped by DOD in accordance with the regulations of the Military Service involved would have to be certified by that Service as providing a degree of safety at least equal to that provided by DOT regulations.

3. When a request for a special permit is submitted to DOT for evaluation one of the deciding factors in issuing the permit is the fact that test data submitted insures that the packaging, although different from DOT regulations, does provide a degree of safety at least equal to those regulations. In other words, DOT has taken the position, that if DOD cannot certify that the commodity being shipped in conformance with their own packaging requirements is, in fact, safe for transport, it should not be shipped in that package. If the packaging is certified to offer a degree of safety equal to the DOT regulations, then a special permit is not required because DOD has been granted the authority of shipping under Section 173.7(a).

4. The Military Services have the responsibility of insuring that packaging of hazardous materials offer a degree of protection to the public at least equal to that which is provided in 170-179 CFR 49. To ask for a special permit for packaging which does not offer the public the same degree of protection provided in CFR 49 would negate the intent of the Hazardous Materials Regulations.

FIGURE 2

HDMTS-SSA (15 Sep 71) 1st Ind 28 September 1971
SUBJECT: Section 173.7(a) CFR 49 Air Force Policy

5. The above interpretation is based on previous correspondence between this headquarters and DOT and further communications with the Office of Hazardous Materials on this subject is not deemed necessary.

FOR THE COMMANDER:

JOHN P. HYDE
Colonel, MFC
Chief, Office of Safety & Security

cy furn:
OHM, DOT

CONTAINER TEST REQUIREMENTS

ROUGH HANDLING TESTS

REFERENCES (METHOD) ARE TO FEDERAL TEST METHOD STANDARD 101B.

TEST

Verify configuration requirements and fit check IAW Para 5.1.2 of MIL-STD-648.

LEAK TEST. Method 5009. Test pressure is 1.5 psig to 2.0 psig. Fail criteria: Less than 0.04 psig loss in 60 min or no loss in 15 min.

*Edgewise Drop (Rotation) Test. Method 5008 at **-20°±5°F and 140°±5°F. Drop height 36 inches.

*Cornerwise Drop (Rotation) Test. Method 5005 ** at -20°±5°F and 140°±5°F. Drop height 36 inches.

*Pendulum Impact Test. Method 5012 at -20°±5°F and 140°±5°F, Test at 7 fps.

*Vibration (Sinusoidal Motion) Test. Method 5020 at ambient temperature. Transmissibility shall be IAW Para 5.3.1.a of MIL-STD-648.

Repetitive Shock. Method 5019.

Superimposed-Load Test. Method 5016 with load equal to one more container than maximum stack.

Mechanical Handling Test. Method 5011, Para 6.2, 6.3, 6.5, and 6.6.

Hoisting Strength Test. IAW Para 5.8.1 of MIL-STD-648.

* Instrumented test using tri-ax accelerometers at C.G. of missile component.

** If section container gross weight is less than 200 pounds, substitute free fall drop tests IAW Method 5007.

FIGURE 3

TEST PURPOSES AND CRITERIA

TYPE TEST	METHOD	QUAL.	CERT.	CRITERIA
LEAK	5009	X		1
VIBRATION	5019	X	173.7(A)	
			173.398	2,3,4,
CORNER DROP	5005	X	173.7(A)	2,4,4,5
EDGEWISE DROP	5008	X	173.7(A)	2,3,4,5
PENDULUM	5012	X	173.7(A)	2,3,4,5
STACKING	5016		173.7(A)	2,4,5
HOISTING	MS 648		173.7(A)	4,5
HANDLING	5011	X	173.7(A)	4,5
4' FREE FALL	CFR		173.398	3,4,5
COMPRESSION	CFR		173.398	4,5,6
PENETRATION	CFR		173.398	6

1 NO PRESSURE DROP (1½ PSI FOR 30 MIN)
2 NO UNACCEPTABLE DAMAGE TO CONTENTS
3 NO SPILLAGE OF CONTENTS
4 CONTAINER FUNCTIONAL
5 NO PERMANENT-DEFORMATION OR UNSAFE CONDITION
6 NO RELEASE OF RADIOACTIVE MATERIAL

FIGURE 4

SEP 26 1980

Colonel Richard Singleton
Chief, Office of Safety and Security
Headquarters, Military Traffic Management
Command, MTMC-SS
Washington, D.C. 20315

Dear Colonel Singleton:

During our meeting on July 25, 1980 regarding the filing of hazard classification approvals we briefly discussed a workload problem that our office is having regarding exemption requests from contractors and sub-contractors for the shipment of various hazardous materials that are in packagings specifically requested by the military services.

Since Headquarters, MTMC (Safety Office) is the single point of contact between DOT and DOD on hazardous materials transportation matters, it is requested that your Office initiate action within DOD to require each military service to work very closely with the contractor and use the provisions of 49 CFR 173.7(a), whenever possible, instead of requiring the contractor to apply for an exemption from DOT (49 CFR 107.103). In most cases, the contractor does not know that an exemption is required until the package is ready to be shipped to or for the DOD. When this happens, the contractor and the intended receiver of the hazardous material push the "panic button" for DOT to issue an emergency exemption or give priority handling to the application.

In addition to the above situation, after an exemption has been issued, normally it cannot be incorporated into the Hazardous Materials Regulations because the packaging does not meet DOT specifications. Therefore, in order to eliminate this type of an exemption, it would be highly beneficial for DOD to stipulate at the very beginning of the contract that, if the packaging does not meet DOT specifications, the DOD will take the necessary action to authorize shipment under 49 CFR 173.7(a), whenever possible. Also, the DOD should become involved and take an active part when these military items are shipped back and forth between contractors. If for some reason an exemption is required, the DOD should plan to work very closely with the contractor in preparing a timely filed application.

Enclosed is a random sample of exemptions that have been issued to contractors for the shipment of packagings that contain military items and are pertinent to this matter. We estimate there are approximately 50 more.

FIGURE 5

We would appreciate your analysis of this proposal and advice as to when it can be implemented. Should you anticipate any problems, perhaps a meeting with our respective staffs would be appropriate.

Sincerely,

ORIGINAL SIGNED BY
ALAN I. ROBERTS

Alan L. Roberts
Associate Director for
Hazardous Materials Regulation
Materials Transportation Bureau

Enclosures

E-6672	6908	6997
7694	7721	7726
7765	7840	7865
7904	8220	8221
8246	8254	8272

DMT-213:DARRELLLRAINES:gp:9-22-80:x472-2727
cc:DMT-213 DMT-20 DMT-21

EXCERPT FROM DOT LETTER OF INTERPRETATION DATED 5 APRIL 1982

TO AD/SD3P, EGLIN AFB, FL

"This is in reply to your letter of 26 March and our meeting with Mr David Volz of your office on 31 March 1982."

"The provisions of 49 CFR para 173.7(a) are not restricted to Subparts A, B, and C. It is our interpretation that the provisions of para 173.7(a) apply to all of the listed Subparts of Part 173, not just A, B, and C."

"With respect to the provisions of para 173.87, the OHMR agrees that the present wording is not clear. Therfore, the MTB is going to propose in a forthcoming notice of proposed rulemaking that para 173.87 be amended to specifically reference para 173.7(a) and 173.86 in order for the DOD to fully implement its Certification of Equivalency (COE) program. During the interim, the DOD is hereby authorized to package together explosives and their related components, which have been examined, classed, and approved by one of the agencies listed in para 173.86(b) and ship them under the provisions of para 173.7(a). This also applies to compressed gas packages and other packages as well."

FIGURE 6

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS ARMAMENT DIVISION (AFSC)
EGLIN AIR FORCE BASE, FLORIDA 32542

AD CONTAINER CERTIFICATION

AF-82-52

This certification is issued to Garrett Pneumatic Systems Division, Phoenix, Arizona, pursuant to 49 CFR 173.7(a) of the Department of Transportation (DOT) Hazardous Materials Regulations, under authority established in AFR 80-18 and AFLC/AFSC 800-29.

1. CONTAINER. The PPP-B-636 Federal Specification corregated fiberboard container packages one control actuation system (CAS) per Garrett Pneumatic Systems Division Drawing 3793000 dated May 1982.

2. COMMODITY. The CAS is a subsystem component of the GBU-15 Common Control Module. The CAS is described in Garrett Corporation Drawing 3200050, Rev. U dated 21 Apil 1981. The CAS assembled contains a nonrefillable steel helium filled pressure vessel, Drawing 3165476, Rev. M dated 6 Nov 1981, fabricated to Specification GPS6060-2, Rev A dated 8 Dec 1981.

a. DOT Proper Shipping Name: Helium.

b. DOT Hazard Class: Nonflammable Gas.

c. DOT Label: NON-FLAMMABLE GAS. CARGO ONLY AIRCRAFT, (air mode).

d. DOT Marking: Helium.

3. TEST REPORTS: Garrett Pneumatic Systems Division, Package 12 Feet Drop Test Report dated 13 April 1982. Authorized Testing, Inc, "Report of Manufacturer of Compressed Gas Cylinders or Spheres" dated 28 Dec 1982. GPS 5114-1 Specification Testing, Welded Nonreuseable, Nonrefillable Pressure Vessel, Rev B dated 23 Nov 1981.

4. SPECIAL PACKAGING REQUIREMENTS:

a. Validate container packaging and marking to Garrett During 3793000 dated May 1982.

b. The CAS shipping container will be marked with Certification Control Number "CCN AF-82-52."

c. Validate maximum service pressure of the helium filled pressure vessel not to exceed 7,800 psig IAW Garrett Drawing 3165476-1.

d. The safety control measures of para 7, DOT-E 6908 (THIRD REVISION) dated 25 Mar 1982 are incorporated by reference and made a part of this Certification of Equivalency (COE).

FIGURE 7

e. All Class I engineering changes affecting CAS packaging or items configuration will be coordinated with the Certifying Office, AD/YXC.

5. SPECIAL TRANSPORTATION REQUIREMENTS:

a. Shipping documents will be marked: "Packaged IAW 173.7(a) 49 CFR, authority CCN AF-82-52."

b. Certification is applicable to cargo-only aircraft and other modes of transportation as authorized in 49 CFR 172.101 for this commodity.

c. A copy of this COE will be furnished to any carrier in commerce used to transport packages authorized by this COE.

6. REFERENCES:

a. US DOT letter dated 5 April 1982 to Chief, Packaging and Transportation Division, Eglin AFB, FL 32542.

b. Garrett Pneumatic Systems Division letter dated 14 April 1982, subject, Request for COE, to AD/SD3P, Eglin AFB, FL 32542.

c. AD Eglin AFB Contracts F08635-80-C-0328 and F08635-82-C-0204.

DATE OF CERTIFICATION: 5 May 1982.

FRED H. CARLEY
Director, Packaging and Transportation, YXC
Deputy for Munitions

D. R. VOLZ
Transportability Agent, YXC
Directorate, Pkg and Trnsp

DEPARTMENT OF TRANSPORTATION EXEMPTIONS
AND
CERTIFICATES OF EQUIVALENCIES
WHICH ARE
APPLICABLE TO THE SHIPMENT
OF
HAZARDOUS MATERIALS
MADE BY
DEPARTMENT OF DEFENSE SHIPPERS
1983
(Revised March 83)

HEADQUARTERS
MILITARY TRAFFIC MANAGEMENT COMMAND
WASHINGTON, DC 20315

FIGURE 8

DEPARTMENT OF DEFENSE

NUMERICAL LIST OF CERTIFICATIONS OF EQUIVALENCY (COE)

DOD CCN NUMBER*	SUMMARY OF PROVISIONS	ISSUE DATE
AIR FORCE ISSUED COE'S		
AF-78-51	Authorizes the CNU-309/E and CNU-332/E containers for packaging GAU-8, 30mm HE and API ammunition. DOT Exemption, DOT-E 8101, also applies to shipments. Certified by AD/SD3P, Eglin AFB FL.	13 Jun 80 Reissue
AF-78-52	Authorizes the CNU-218/E for packaging two SUU-54 dispenser munitions. Certified by AD/SD3P, Eglin AFB FL.	24 Apr 78
AF-79-01	Authorizes Convair Report ALCM 1822 interim shipping container for the AGM-109 Air Launched Cruise Missile during Full Scale Engineering Development. Certified by HQ AFSC/LGT, Andrews AFB, DC.	30 Mar 79 Revised
AF 79-02	Authorizes Martin Marietta Packaging Process Plan, PTV Missile Container, Rev C for the Advanced Strategic Air Launched Missile with propulsive state motor. Certified by HQ AFSC/LGT, Andrews AFB, DC.	17 Jan 79
AF 79-03	Authorizes one time shipment of F-16 canopy with with detonation devices installed in packaging authorized for canopy without detonation devices. Certified by HQ AFSC/LGT, Andrews AFB, DC.	1 Mar 79
AF 79-04	Authorizes DOT 3E1800 cylinder packed in vermiculate cushioned fiberboard box for a one time shipment of 500 cc samples of anhydrous hydrazine. Certified by HQ AFSC/LGT, Andrews AFB, DC.	28 Mar 79

DOD CCN NUMBER*		ISSUE DATE

SUMMARY OF PROVISIONS (cont)

AF 79-05	Authorizes the F-16 EPU Hydrazine Fuel Tank overpacked in Tainer Tech container (dwg no. 2120-1) for a 70/30 hydrazine/water for F-16 Emergency Power Unit. Certified by HQ AFSC/LGT, Andrews AFB, DC.	17 May79 Revised
AF 79-07	Authorizes Thiokol case 7U1560 overpacked in lifting and rotating fixtures 2U64133 for cast propellant (TP-H1202). Certified by HQ AFSC/LGT, Andrews AFB, DC.	16 Jul 79
AF 79-08	Authorizes McDonnell Douglas Astronautics Company packaging per drawings 11243423 and A2-ACFO-265, Figure 2 for Spartan Control Sections containing nitrogen, explosives power devices. Certified by HQ AFSC/LGT, Andrews AFB, DC.	11 Sep 79
AF 79-09	Authorizes packaging configuration of McDonnell Douglas Astronautics Drawing 1D40661 for the AMaRV reentry vehicle containing nonflammable gases. Certified by HQ AFSC/LGT, Andrews AFB, DC.	30 Dec 80 Reissued
AF-79-51	Authorizes the CNU-205/E, CNU-325/E, and CNU-326/E for multi-packaged AIM-7E and AIM-7F all-up-round missiles. Certified by AD/SD3P, Eglin AFB FL.	2 Apr 79
AF-79-52	Authorizes the CNU-282/E and M548 containers for the TMU-72/B coolant pressure tank. Certified by AD/SD3P, Eglin AFB FL.	8 Jun 79
AF-79-53	Authorizes the CNU-248/E container for MK-39 MOD 7, MK 78 MOD 0, and AGM 45 rocket motors in a propulsive state. Certified by AD/SD3P, Eglin AFB FL.	17 Sep 79

DOD CCN NUMBER*		ISSUE DATE
	SUMMARY OF PROVISIONS (cont)	
AF-79-54	Authorizes the CNU-289/E for multi-packaging the AIM-9L MK36 rocket motors and the CNU-302/E for multi packaging AIM-9P SR116 rocket motors. Certified by AD/SD3P, Eglin AFB FL.	17 Sep 79
AF-79-55	Authorizes the S.A.M.P., CN.024.E.79 container for multi packaged Durandal Penetration bombs. Rocket ammunition with explosive projectiles. Certified by AD/SD3P, Eglin AFB FL.	26 Oct 79
AF-79-56	Authorizes the CNU-327/E container for twin-packed Tactical Munition Dispensers (TMD) Explosive Bomb. Certified by AD/SD3P, Eglin AFB FL.	8 Jan 80
AF-79-201	Authorizes shipment of Nitrogen (F 111 Pressure Source) in accordance with Transportation Packaging Order (TPO) 1560 00835 1326J. Certified by HQ AFLC/LOZP	22 Jun 79
AF 80-01	Amended AF-79-01 to add 18 Dispenser Ejector Gas Generators, 18 Submunition Dispersal Changes and 1 Guidance System District Device to already approved shipping configuration. Approved by HQ AFSC/LGTV Andrews AFB, DC.	4 Feb 80
AF-80-51	Authorizes the Thompson-Brandt AGM 252-332 MOD B container for multi-packaged BAP-100 Runway Penetration Bombs. Rocket ammunition with explosive projectiles. Certified by AD/SD3P, Eglin AFB FL.	1 Aug 80
AF-80-52	Authorizes the UTC 2537 container for packaging the Super Bates cast propellant grain, TPN 1034 in Case C11241-01-01. Propellant explosives. Certified by AD/SD3P, Eglin AFB FL.	22 Aug 80

DOD CCN NUMBER*		ISSUE DATE
	SUMMARY OF PROVISIONS (cont)	
AF-80-53	Authorizes the Boeing Aerospace Company container, SC 2182002-101, for packaging the Air Launched Cruise Missiles (AGM-86/B) in three configurations. DOT Exemption DOT-E 8086 (PTE) dated 15 Sep 80 and DOT-E 8086 dtd 30 Aug 79 also applies to shipment. Certified by AD/SD3P, Eglin AFB FL.	30 Oct 80
AF 80-54	Authorizes the ASPC T-1027922 container base and the Sanford 1-6207-F cover for packaging the LSB rocket motor. DOT Exemption, DOT-E-5022 dtd 17 Dec 79 also applies to shipment. Certified by AD/SD3P, Eglin AFB FL.	3 Nov 80
AF 80-201	Authorizes 4 inside containers, each containing 12 each glass ampoules with not more than 3 cc of nitrogen dioxide to be tightly fitted in a fiber-board box, which is enclosed in a heat sealed bag. Certified by HQ AFLC/LOZP	20 Jun 80
AF 80-202	Authorizes shipment of Hydrazine Unsymmetrical Dimethylhydrazine (UDMH) in glass ampoules. Certified by HQ AFLC/LOZP.	23 Jun 80
AF-80-203	Authorizes shipment of Chloroacetophenone (CN) in containers identified as "Streamer" and "Mini-Streamer". Certified by HQ AFLC/LOZP	16 Oct 80
AF-81-01	Authorizes United Technologies Corporation to ship the Inertial Upper Stage Solid Rocket Motor (IUS SRM-1) in a specified container with an associated temperature control unit. Certified by HQAFSC/LGTV Andrews AFB, DC Mode: Motor vehicle.	26 Feb 81

DOD CCN NUMBER*	SUMMARY OF PROVISIONS (cont)	ISSUE DATE
AF-81-02	Authorizes Thiokol Corporation to ship the ASPD Loaded Case Assembly and the ASPD Loaded Propellant Cutback Case between Thiokol/Wasatch Division and Thiokol/Elton Division in a specified container. Certified by HQAFSC/LGT, Andrews AFB, DC Mode: Motor vehicle.	26 Feb 81
AF-81-03	Authorizes Rockwell International to ship the MX Stage IV in a specified container between RI/Rocketdyne Division and Arnold Engineering Development Center, Approved Engineering Test Laboratory, and Vandenberg AFB. Certified by HQAFSC/LGT, Andrews AFB, DC. Mode: Motor vehicle.	11 Mar 81
AF-81-03-2	Amended CCN AF-81-03, authorizes shipment of MX Stage IV through FY 82; shipping container is slightly modified version of AF-81-03, and Stage IV may be shipped in two possible configurations. Certified by HQAFSC/LGT, Andrews AFB, DC. Mode: Motor vehicle.	16 Oct 81
AF-81-04	Authorizes Weber Aircraft, Division of Walter Kidde & Company to ship the ACES II Ejection Seat in a specified container; reshipment of these ejection seats are authorized. Certified by HQAFSC/LGT, Andrews AFB, DC. Mode: Motor vehicle, rail freight, aircraft.	27 May 81
AF-81-05	Authorizes United Technologies Corporation to ship the Inertial Upper Stage Solid Rocket Motor (IUS SRM-II) in a specified container with associated temperature control unit. Certified by HQAFSC/LGT, Andrews AFB, DC.	4 Dec 81
AF-81-05	Revision 2 - Authorizes (IUS-SRM II) to be shipped in a propulsive state with the igniter installed.	11 Dec 81
AF-81-05	Change 1 - Added Boeing Co. as shipper; shipments are authorized with or without igniter installed; amended marking requirements.	29 Jan 82
AF-81-05	Change 2- Added shipments are authorized without nozzle assembly installed. Mode: Motor vehicle	13 Apr 82

SUMMARY OF PROVISIONS (cont)

DOD CCN NUMBER*		ISSUE DATE
AF-81-06	Authorizes Aerojet Strategic Propulsion Company to ship MX Stage II developmental stages DS-3 and-3A between ASPC and the Arnold Engineering Development Center in a specified container. Certified by HQAFSC/LGT, Andrews AFB, DC.	16 Sep 81
AF-81-06	Revision 1-Authorizes Aerojet Strategic Propulsion Company to Ship development Stage (DS-6) described in Drawing Number 1175388-1 from ASPC to the Arnold Engineering Development Center Mode: Motor Vehicle. Note: AF-81-06 Superseded by AF-82-27	9 Apr 82
	Revision 2 - Replaces AF-81-06 dated 16 September 81, and First Revision dated 092112 APR 82. Authorizes shipment of various test configurations of MX Stage II in Aerojet Shipping Containers, and approves return shipments following testing at AEDC or AFRPL. Mode: Motor Vehicle *NOTE: AF-81-06 SUPERSEDED BY AF-82-27	13 APR 82
AF-81-07	Authorizes General Dynamics Convair Division to ship the TOMAHAWK Ground Launched Cruise Missile (GLCM) in a specified container; missile configuration changes will require reissuance of the COE. Certified by HQAFSC/LGT, Andrews AFB, DC	18 Sep 81
AF-81-07	Change 2 authorizes the shipment of the BGM-109G in the CNM-308/E container via military air.	16 Feb 82
AF-81-07-1	Amends COE AF 81-07 to approve shipment of "in-work" missles between two General Dynamics plants. Mode: Motor vehicle.	28 Jan 82
AF-81-08	Authorizes Thiokol Corporation to ship the Improved Performance Space Motor (IPSM-II) with installed igniter in a specified container. Certified by HQAFSC/LGT, Andrews AFB,	2 Nov 81
AF-81-08	Added hazard classification of components shipped in ISPM-II shipping container. Mode: Motor freight.	1 Dec 81

DOD CCN NUMBER*	SUMMARY OF PROVISIONS (cont)	ISSUE DATE
AF-81-09	Authorizes United Technologies Coroporation to ship the flight coolant assembly for MX in a specified container. Mode: Motor freight, rail, aircraft.	16 Dec 81
AF-81-205	Authorizes shipment of Nitrogen or Air Compressed in non-DOT nonrefillable cylinders. Certified by HQ AFLC/ LOZP	13 May 81
AF 81-206	Authorizes shipment of small starter cartridges and oxygen cylinder with elecric squib assembly on F 107 Engine. Certified by HQ AFLC/LOZP. 1981.	14 Oct 81
AF-82-01	Authorizes Thiokol Corporation to ship the Improved Performance Space Motor (IPSM-II) with installed igniter in a specified container. Certified by HQ AFSC/LGT, Andrews AFB, DC Mode: Motor freight.	8 Feb 82
AF-82-03	Authorizes shipment of MX Stage II rocket motors in a propulsive state with igniters installed in containers manufactured by the Goodyear Areospace Corporation. Certified By HQ AFSC/LGT, Andrews AFB, DC, Modes Authorized: Rail, Motor Freight.	12 APR 82
AF-82-04	Authorizes one time shipment of United Technologies Corporation CSD/SEP Advanced Apogee Rocket Motor in Energie Propulsion Industrie Container BX 4722. Mode: Motor Vehicle Certified by HQ AFSC/LGT, Andrews AFB, DC.	3 AUG 82
AF-82-05	Authorizes one-time shipment of Improved Space Motor in a propulsive state as detailed in United Technologies Chemical Systems Division Drawing: 8038-092 Mode: Motor Freight Certified by HQ AFSC/LGT. Andrews AFB, DC	1 NOV 82

DOD CCN NUMBER*		ISSUE DATE

SUMMARY OF PROVISIONS (cont)

AF-82-06	Authorizes shipment of the ASAT Maneuver Propulsion Assembly in a propulsive state as detailed in Atlantic Research Corp. Drawing Number A0157033. Mode: Motor Freight or Cargo Aircraft Only Certified by HQ AFSC/LGT, Andrews AFB, DC.	15 Dec 82 (expires 30 Jun 84)
AF-82-20	Authorizes shipment of the M-X Stage III Rocket Motor in a propulsive state with specified packaging and container design prescribed in Hercules Strategic Systems Drawings 83310J00198 and 83310S00307. Mode: Motor Vehicle Certified by BMO/SDML, Norton AFB, CA.	23 AUG 82
[illegible]	Authorizes shipment of the M-X Stage I Rocket Motor in a propulsive state with igniters installed as detailed in Goodyear Aerospace Corp. Drawings 5029002-006 and 5029302-003 (highway shipment) and Martin-Marietta Corp. Drawing 863T0190009 in the Goodyear Container 5029302-003 (rail shipment) Mode: Motor Freight or Rail Certified by BMO/SDML, Norton AFB, CA.	19 Jul 82
AF-82-22	Authorizes shipment of the M-X Stage IV Rocket Motor in a propulsive state as detailed in Rocketdyne Drawings RK392-40041 and RK396-00003. Mode: Motor Vehicle Certified by BMO/SDML, Norton AFB, CA.	26 AUG 82
AF-82-24	Authorizes Shipments of the M-X Shroud Tractor Motor in a propulsive state as detailed in Atlantic Research Corp Drawing No. A0186063. Mode: Motor Vehicle Certified by BMO/SDML, Norton AFB, CA.	26 AUG 82
AF-82-25	Authorizes shipment of the M-X Stage III Rocket Motor in a propulsive state as detailed in Goodyear Aerospace Corp Drawing 5029314-020, 5029002-006 (highway Shipment) and Motor-Marietta Corp Drawing 863T019009 (rail shipment). Mode: Motor Vehicle or Rail. Certified by BMO/SDML, Norton AFB, CA.	26 AUG 82

DOD CCN NUMBER*	SUMMARY OF PROVISIONS (cont)	ISSUE DATE
AF-82-27	Authorizes shipment of the M-X Stage II Rocket Motor in a propulsive state with igiters installed as detailed in ASPC Drawing T-1040186. Mode: Motor Vehicle Certified by BMO/SDML, Norton AFB, CA. *NOTE: Supersedes CCN AF-81-06	8 Sep 82
AF-82-28	Authorizes shipment of M-X PTOS installed on fired M-X Stage II Rocket Motors as detailed in ASPC Drawing No. T-1040186. Mode: Motor Vehicle Certified by BMO/SDML, Norton AFB, CA	28 Sep 82
AF-82-29	Authorizes shipment of propellant explosive used in the M-X Stage II Rocket Motor as detailed in Aeroject Strategic Propulsion Co. Letter M-X:82:L:3495 dated 6 Dec 82. Mode: Execlusive Use Motor Freight Certified by BMO/SDML, Norton AFB, CA.	8 Dec 82 (expires 3 Jan 83)
AF-82-30	Authorizes shipment of tungsten hexafluoride packaged as detailed in Sandia National Laboratories Drawing No. 543560, and overpacked in a strong fiberboard box with cushioning material filling all voids. Mode: Motor Freight or Cargo Aircraft Only Certified by BMO/SDML, Norton AFB, CA.	3 Dec 82 (expires 3 May 83)
AF-82-51	Authorizes shipment of one GBU-15 Control Module or Unit (WCU 6/B, WCU-8/B, WCU-9/B) containing a steel helium filled pressure vessel, thermal battery and actuation valve in the CNU-271/E container. Safety control measures of para 7, DOT-E-6908 (Third Revision) as in effect 25 Mar 1982 are incorporated by reference. Certified by AD/YXC, D.R. Volz, Eglin AFB FL. Issued: 20 April 1982. Auth Modes: MIL-AIR, and as authorized in 49 CFR 172.101 for this commodity.	20 Apr 82

DOD
CCN NUMBER*

ISSUE DATE

SUMMARY OF PROVISIONS (cont)

AF-82-52	Authorizes shipment of one Control Actuation System, a component of the GBU-15 Common Control Module, containing a steel helium filled pressure vessel, manufactured by Garrett Pneumatic Systems Division, Phonenix AZ to GSPD dwg 3793000, May 82, packaged in a PPP-B-636 federal specification corregated container. Safety control measures of para 7, DOT-E-6908 (Third Revision) as in effect 25 Mar 1982 are incorporated by reference. Certified by AD/YXC, D.R. Volz, Eglin AFB, FL. Issued: 5 May 1982 1st revision, 15 Nov 1982, - authorizes (1) An alternate lot size definition and (2) Packaging for replacement pressure vessels. Auth Modes: MIL-AIR, cargo only Aircraft, and as authorized in 49 CFR 172.101 for this commodity.	5 May 82 15 Nov 82
AF-82-53	Authorizes shipment of two propulsive rocket motor booster assemblies, described in Hercules dwg no. 60349A20006, Rev B. Packaging is a solid, nailed wooden box per Hercules dwg 60349S61002, Rev A. Certified by AD/YXC, D.R. Volz, Eglin AFB FL. Auth Modes: MIL-AIR and as authorized in 49 CFR 172.101 for this commodity.	19 July 82
AF-82-54	Authorizes shipment of four propulsive rocket motor sustainer assemblies described in Hercules Aerospace Division dwg no. 60350A20006, Rev B. Packaging is a solid, nailed wood box described in Hercules dwg 60350561001, Rev A. Certified by D. R. Volz, AD/YXC, Eglin AFB FL. Auth Modes: MIL-AIR and other modes as authorized in 49 CFR 172.101 for this commodity.	19 July 82
AF-82-55	Authorizes shipment of one Missile Fin Actuation System and one steel, helium filled pressure vessel assembly, manufactured by Garrett Pneumatic Systems Division, Garrett P/N's 3268888 and 3236032. Packaging is a PPP-B-636 federal specification corrugated fiberboard container. Certified by D. R. Volz, AD/YXC, Elgin AFB FL. Auth Modes: MIL-AIR, cargo only aircraft, and other modes authorized by 49 CFR 172.101 for this commodity.	29 July 82

DOD CCN NUMBER*		ISSUE DATE
	SUMMARY OF PROVISIONS (cont)	
AF-82-56	Authorizes shipment of MATRA Durandal Rocket Motors in a propulsive state packed in nailed wood boxes as detailed in SEP Drawing F-65723 and palletized as detailed SEP Conteneur Pour, RP 30 drawing Mode: Military Cargo Only Aircraft, Motor Vehicle Certified by: AD/YXC, Elgin AFB, FL.	26 Aug 82
AF-82-57	Authorizes shipment of the WGU-12/B Guidance and Control Unit containing helium in a non-refillable, steel high pressure gas bottle encapsulated in polyethylene foam and packed in a CNU-317/E shipping container. Mode: Motor Freight, Rail, or Cargo Aircraft Only (Civilian or Military). Certified by AD/YXC, Eglin AFB, FL.	28 Oct 82
AF-82-58	Authorizes Shipment of the AN/DSQ-35 Guidance and Control Unit encased in polyethylene foam and packed in quantities of eight per CNU-369/E Shipping Container. Mode: Motor Freight, Rail or Cargo Aircraft Only (Civilian or Military) Certified by AD/YXC, Eglin AFB, FL.	15 Nov 82
AF-82-207	Authorizes shipment of LUU-10 smoke signals in a Navy MK-15 MOD-O metal container. Mode: Motor freight, rail, Cargo-only aircraft, and military cargo-only aircraft. Certified by HQ AFLC/LOZP.	4 May 82
AF-83-01	Authorizes shipment of ASAT Hydrazine Tank Assembly containing anhydrous hydrazine as detailed in Hamilton Standard Part No. SV779281 CT004, and packed in accordance with Hamilton Standard Specification PK 4308, dated 20 Oct 82. Mode: Motor Freight or Cargo Aircraft Only Certified by HQ AFSC/LGT, Andrews AFB, DC.	17 Jan 83 (expires 31 Mar 84

DOD CCN NUMBER*		ISSUE DATE
	SUMMARY OF PROVISIONS (cont)	
AF-83-51	Authorizes shipment of steel helium filled pressure vessels (8.800psig). Items are packaged five ea. to a PPP-B-636 fiberboard container, encapsulated in polyurethane foam cushioning per dwg SK 7398. Issued by D.R. Volz, AD/YXC, Eglin AFB FL, Auth Modes: MIL-AIR, cargo only aircraft and motor vehicle	14 Jan 83
NAVY ISSUED COE'S		
NA 80-500	Authorizes shipment of PENGUIN missile rocket motors in a propulsive state packed in strong wooden boxes of Norwegian design and manufacture during US R&D of missile system. (Dispatch authorization)	15 Jan 80
NA-80-501	Authorizes shipment of class C Explosive Power Device for HARPOON Sustanier Engine in MK 621 Container.	
NA 80-502 (Revision A)	Authorizes shipment of a charged survival support device, NSN 4420-00-022-1048 as Accumulator, Pressurized in a fiberboard box. Intermediate pack is a bundle of 8 units secured with filamant reinforced tape. Consolidation container, with a maximum of 96 units is a pallet crate conforming to drawing 53711-5166665.	27 May 80
NA 80-503	Authorizes shipment of TRIDENT I C-4 Nose fairings in MIL-C-26195 container per LMSC Packaging Data sheet PP-66285. Installed small rocket motors (two) are in a propulsive state.	
NA 80-504	Reserved and never issued.	
NA 80-505	Authorizes tactical shipment of up to ten electric or non-electric blasting caps in same vehicle with other demolition materials when packed in MK 663 Mod O container.	7 Jul 80
NA 80-506	Reserved and never issued.	

DOD CCN NUMBER*		ISSUE DATE
	SUMMARY OF PROVISIONS (cont)	
ARMY ISSUED COE'S		
AY 80-001	Authorizes L8A1 smoke grenades to be packaged in a metal ammunition container for surface and air shipments.	9 May 80
AY 80-181	Authorizes use of Cylindrical Metal Exterior container containing two Eject Missile Assemblies in Lieu of specification wood box. (Vapor barrier 6lb FT 3 foam interior supports).	2 Jul 80
AY 81-182	Authorizes use of Aluminum pressure vessel containing nitrogen gas used in GLLD system in lieu of DOT specified steel cylinder.	19 Nov 81
AY 82-023	COE certifies that 25mm M790 series ammunition packaged in the M621 container and palletized or overpacked meets DOT criteria. The M790 series ammunition consists of M791 APDS-T, M792 HEI-T, and M793 TP-T cartridges. The cartridges are packaged and palletized separately, 30 linked cartridges per M621 container and 27 containers per pallet.	9 July 82
AY 121-82	The TAM-4 high pressure cylinder for the AN/TAS-4, 5, and 6 night vision equipment was issued a COE by the US Army Electronics Research and Development Command (Adelphi, Maryland) on 16 August 1982 to expire on 16 August 1984.	16 Aug 82
AY 82-183	Authorizes use of a metal container for First stage of Pershing II Missile System, in lieu of DOT specified wood box.	15 Jan 82
AY 82-184	Authorizes use of a metal container for Second stage of Pershing II Missile System, in lieu of DOT specified wood box.	15 Jan 82

DOD CCN NUMBER*		ISSUE DATE
	SUMMARY OF PROVISIONS (cont)	
NA 80-508	Authorizes shipment of dry charged AQM-37A target drove batteries in same package as 14 liquid ounces of alkaline battery electrolyte in 28 one half ounce polyetheylene bottles.	20 Oct 80
NA 80-509	Authorizes shipment of practice bomb cartridge signals loaded with titanium tetrachloride. Fifty signals are packed in an M2A1 box as shown in dwg 30003-X1302AS200.	29 Oct 80
NA 81-500	Authorizes shipment of chlorate candles, NSN 1H 4460-00-875-4568, in metal cans with packaged ignition device tape to outside fiberboard shipping container. DOT E-6540 covers shipment [illegible]	23 Jan 81
NA 81-501	Authorizes shipment of emergency escape breathing devices, dwg 53655-802400, in their polyethylene carrying cases packed in fiberboard boxes, DOT 12B30.	20 Mar 81
NA-82-500	Authorizes all-mode shipment of a non-flammable compressed gas in a unit conforming to drawing 21562-28660 overpacked five(5) to a PPP-B-636 fiberboard box.	26 July 82
NA-82-501	Authorizes Shipment by Motor vehicle, rail freight, cargo vessel and cargo only aircraft of Mobile Targets, MK 38 Mods 1/2/3/4, packed in weather resistant fiber boxes pursuant to DOT E-7052 as lithium batteries and hazard classification Flammable Solid.	21 Oct 82
NA-82-504	Authorizes shipment of MK 106 MOD 0 rocket, in a propulsive state in a wooden box conforming to Atlantic Research Drawing A0116039.	15 Nov 82

DOD
CCN NUMBER* | ISSUE DATE

SUMMARY OF PROVISIONS (cont)

DOD CCN NUMBER*		ISSUE DATE
AY-122-83	The TAM-4 high pressure cylinder for the AN/TAS-4, 5, and 6 night vision equipment was issued a COE by the US Army Electronics Research and Development Command (Adelphi, MD) on 31 January 1983, to expire on 31 January 1985.	31 Jan 83 (expires 31 Jan 85)
AY-83-187	Allows shipment of STINGER system Gas Pumping Unit Charged with ARGON Gas 100 psi. Modes: Air, Water, Rail, Motor. Certified by US Army Missile Command.	3 Jan 83

*Certification Control Numbers (CCN) are issued by the Services and the Defense Logistics Agency pursuant to Joint Logistical Commander Regulation AFLCR 800-29; AFSCR 800-29; DARCOM-R 700-13; NAVMATINST 4030.11; DLAR 4145.37. The CCN is a standardized alpha-numeric system used to identify containers for hazardous materials packaging that have been certified under the provisions of 49 CFR 173.7(a).

POINTS OF CONTACT
CERTIFICATES OF EQUIVALENCY

COE's Numbered	Point of Contact	Mailing Address	Phone Number
	ARMY		
All	Mr. Thomas M. Horan	Director, DARCOM Packaging Storage and Containerization Ctr. ATTN: SDSTO-TP-P Tobyhanna, PA 18466	AUTOVON 795-7683
	AIR FORCE		
	AFSC		
AF-XX-001 thru AF-XX-050	Mr. Joe Maloney, Jr.	HQ, AFSC/LGTV Andrews Air Force Base, DC 20334	AUTOVON 858-3205
	AFSC/AD		
AF-XX-051 thru AF-XX-100	Mr. Dave Volz	HQ, AD/YXC Eglin Air Force Base, Florida 32542	AUTOVON 872-5340/3978
	AFLC		
AF-XX-100 thru AF-XX-300	Mr. Stan Geniusz	HQ, AFLC/LOZP Wright Patterson AFB, Ohio, 45433	AUTOVON 787-4503/3023
	NAVY		
NA-XX-500 thru NA-XX-599	Mr. G.S. Mustin	CDR, Naval Sea Systems Command, Sea 62C2, Washington, DC 20362	AUTOVON 222-1917/1855

SHIPPER CERTIFICATION

(172.204(A), 49 CFR)

"THIS IS TO CERTIFY THAT THE ABOVE - NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION."

VUGRAPH 1

CIVIL PENALTIES

49 CFR

SECTION 107.343(A).

"A PERSON WHO KNOWINGLY VIOLATES A REQUIREMENT OF THIS SUBCHAPTER APPLICABLE TO THE TRANSPORTING OF HAZARDOUS MATERIALS OR TO THE CAUSING OF THEM TO BE TRANSPORTED OR SHIPPED IS LIABLE FOR A CIVIL PENALTY OF NOT MORE THAN $10,000 FOR EACH VIOLATION. WHEN THE VIOLATION IS A CONTINUING ONE, EACH DAY OF THE VIOLATION CONSTITUTES A SEPARATE OFFENSE."

SECTION 107.343(B).

"A PERSON WHO KNOWINGLY VIOLATES A REQUIREMENT OF THIS SUBCHAPTER APPLICABLE TO THE MANUFACTURE, FABRICATION, MARKING, MAINTENANCE, RECONDITIONING, REPAIR OR TESTING OF A PACKAGE OR CONTAINER WHICH IS REPRESENTED, MARKED, CERTIFIED OR SOLD BY THAT PERSON FOR USE IN THE TRANSPORTATION OF HAZARDOUS MATERIALS IN COMMERCE IS LIABLE FOR A CIVIL PENALTY OF NOT MORE THAN $10,000."

CRIMINAL PENALTIES

49 CFR, SECTION 107.371.

"SECTION 110(B) OF THE ACT (49 U.S.C. 1809(B)) PROVIDES A CRIMINAL PENALTY OF A FINE OF NOT MORE THAN $25,000 AND IMPRISONMENT FOR NOT MORE THAN FIVE YEARS, OR BOTH, FOR ANY PERSON WHO WILLFULLY VIOLATES A PROVISION OF THE ACT OR A REGULATION ISSUED UNDER THE ACT."

VUGRAPH 3

49 CFR

SECTION 173.7(A)

"SHIPMENTS OF HAZARDOUS MATERIALS OFFERED BY OR CONSIGNED TO THE DEPARTMENT OF DEFENSE (DOD) OF THE US GOVERNMENT MUST BE PACKAGED, INCLUDING LIMITATIONS OF WEIGHT IAW THE REGULATIONS IN THIS SUBCHAPTER OR IN CONTAINERS OF EQUAL OF GREATER STRENGTH AND EFFICIENCY AS REQUIRED BY DOD REGULATIONS. HAZARDOUS MATERIALS SHIPPED BY DOD UNDER THIS PROVISION MAY BE RESHIPPED BY ANY SHIPPER TO ANY CONSIGNEE PROVIDED THE ORIGINAL PACKAGING HAS NOT BEEN DAMAGED OR ALTERED IN ANY MANNER."

SECTION 173.7(A)(1)

"HAZARDOUS MATERIALS SOLD BY THE DOD IN PACKAGINGS THAT ARE NOT MARKED IAW THE REQUIREMENTS OF THIS SUBCHAPTER MAY BE SHIPPED FROM DOD INSTALLATIONS IF THE DOD CERTIFIES IN WRITING THAT THE PACKAGINGS ARE EQUAL TO OR GREATER IN STRENGTH AND EFFICIENCY THAN THE PACKAGING PRESCRIBED IN THIS SUBCHAPTER. THE SHIPPER SHALL OBTAIN SUCH A CERTIFICATION IN DUPLICATE FOR EACH SHIPMENT. HE SHALL GIVE ONE COPY TO THE ORIGINATING CARRIER AND RETAIN THE OTHER FOR NO LESS THAN 1 YEAR."

VUGRAPH 4

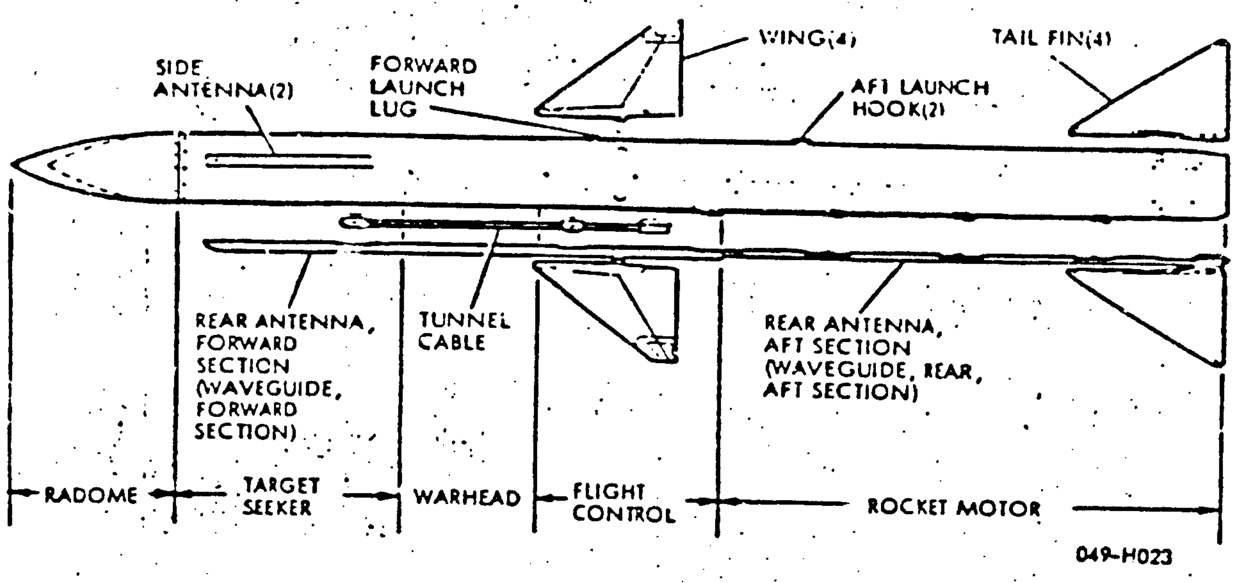
CONTAINER CERTIFICATION OF EQUIVALENCY

MANAGEMENT REQUIREMENT

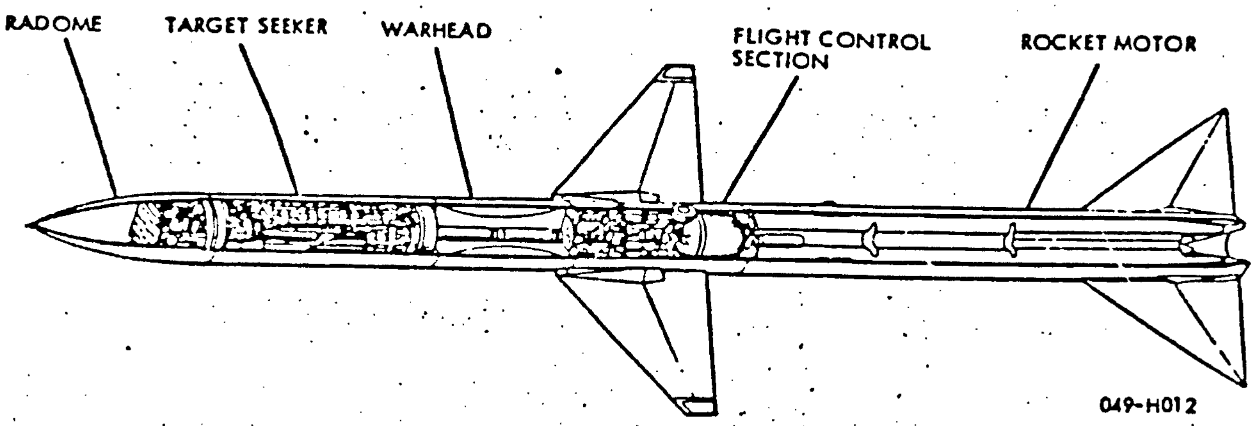
- OBTAIN/REVIEW CONTAINER DRAWINGS, TEST REPORTS, 3311/B TECHNICAL DATA
- REVIEW IN DETAIL 49 CFR REQUIREMENTS
- COORDINATE WITH SAFETY OFFICES FOR HAZARD CLASSIFICATION
- DETERMINE/COORDINATE CONTAINER/VEHICLE TEST REQUIREMENTS, REPORTS
- PREPARE DOT EXEMPTION APPLICATION (IF REQUIRED)
- ISSUE CERTIFICATES OF EQUIVALENCY
- MAINTAIN OFFICIAL FILES FOR REVIEW/REVISION/DISTRIBUTION THROUGHOUT DOD

VUGRAPH 5

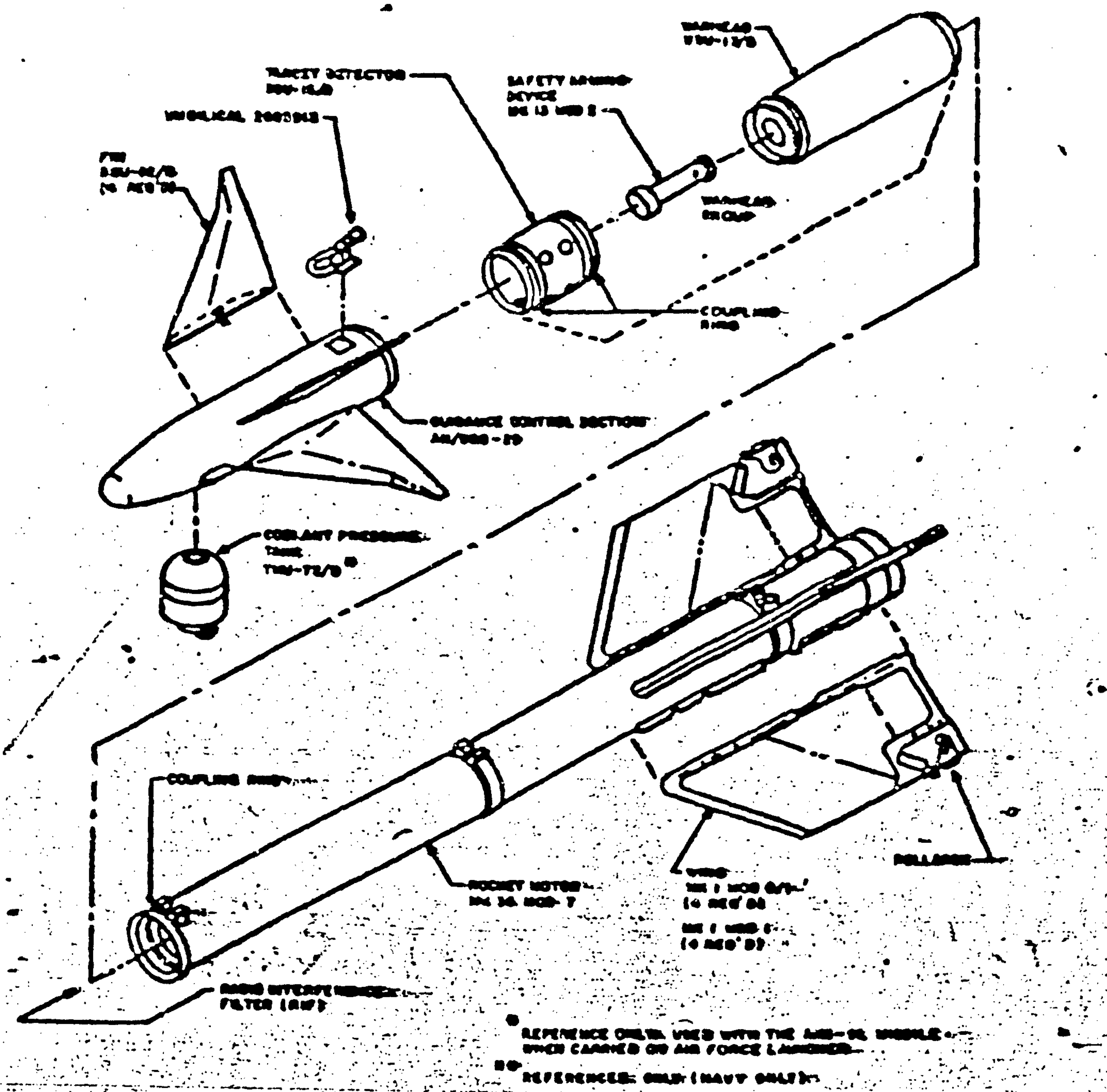
UNCLASSIFIED



(U) Figure E-1 - Sparrow III Guided Missile, Model AIM-7F



AIM-7F Missile Cutaway View



Sidewinder AIM-9L Missile

PRESENTATION TO

PACKAGING, HANDLING AND TRANSPORTABILITY DIVISION

OF THE

AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

ON

DESIGN FOR TRANSPORTABILITY OF OUTSIZED CARGO INCLUDING SHOCK AND VIBRATION ANALYSIS

BY

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AT

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA
26-28 APRIL 1983

DESIGN FOR TRANSPORTABILITY OF OUTSIZED CARGO INCLUDING SHOCK AND VIBRATION ANALYSIS

Design Configurations which cause Transportability problems are those which result in an oversized, overweight, fragile, dangerous or hazardous item being offered for Transportation. Military Specification MIL-P-9024 "Packaging, Handling, and Transportability in System/Equipment Acquisition" established criteria for transportability problems such as: exceeds either 8 feet in height, 8 feet in width, 32 feet in length or 11,200 pounds in their transportation configuration plus other criteria, i.e., dynamic limitations, environmental limitations or hazardous effects.

Viewgraph 1 depicts a relative simple Transportability Problem item. It is a transition duct that was transported from TRW's Capistrano Test site to White Sands Missile Range New Mexico. As you can see it is oversize being 16 feet 10 inches off the road bed and 10 feet 5 inches wide thus requiring permits routing it all over the country side avoiding bridges and underpasses on its way to White Sands. The only Packaging/Packing requirements were simply to secure it to the flat bed trailer.

Viewgraph 2 depicts a more difficult Transportability Problem item. It is a MIL-C-104 crate for an over width item loaded on a flat bed. Note the extra skids that were designed into the crate to support the load on the flat bed trailer. I can not overstate the need to use proven Military Specification load bearing base and crates when it is necessary to package and pack oversize hardware.

The remaining viewgraphs are really what "designed for transportability" is all about. The item that had to be transported is the FLTSATCOM Satellite UHF Transmit Antenna that is very sensitive and fragile and requires application of unique packaging and shock mitigating device for movement.

In addition furtherance of the packaging technology state-of-the-art was required to protect the antenna during handling, transportation and range testing. Part of the preservation and packaging required was to protect the mast with Aclar (Point out on view graph) for contamination for intermodulation product. I know you are wondering what is an intermodulation (IM) product. It is when two or more signals are received or transmitted by an antenna that act like a diode and produce harmonics. This can be caused by metal particles, scratches, cuts, dissimilar metals, bad joints or contamination (dust, etc.) introduced during the fabrication and build up of antenna hardware. It should be noted that during the build-up and component testing of antenna hardware Nylon C was used as a contamination barrier. This material transferred a residue to the thermal paint and created hot spots during orbital operation of the satellite; thus the testing and use of Aclar. I would also like to point out (show on view graph) the transporter base used for inplant and intraplant handling of the antenna. The transporter as you can see is an all wood (dowl and glued) construction, no metal fasteners are used at all, thus allowing use for handling of antenna in anechoic chamber during testing. (Show viewgraph)

The FLTSATCOM Transmit Antenna is shipped during inter-site moves within a clean-tent assembly. Antenna and tent are in turn installed in a wood shipping container. The shipping container measures 9 feet 1 inch by 8 feet by 14 feet 1 inch and, with antenna installed, weights about 3000 lbs. The shipping container is transported on a commercial low-bed trailer. Overall height of the shipping container above the road bed is 16 feet 3 inches which exceeds the legal highway height limit of 13 feet 6 inches. Special routing and permits were therefore required.

Peterbuilt tractor with dual rear axles and 10.00-22 tires. Tires pressurized to 75 psig.

Transmit antenna trailer installation, complete with:

Shipping Container

Tent installation

Isolation system

- Four Firestone #16 single convolution airbags pressurized to 90 psig.
- Four Monroe #6071 automotive shock absorbers.

One 10,000 lb, 60 inch diameter ballast weight centered forward on the trailer goose neck.

One 10,000 lb, 60 inch diameter ballast weight centered aft over the trailer wheels.

FLTSATCOM UHF transmit antenna.

A planar mathematical model was developed to represent the tractor, trailer, and shipping container assembly. This system was modeled with:

a) Three flexible bodies representing the tractor, trailer, and trailer rear axle walking beam.

b) Five point masses representing each axle and wheels.

c) A rigid mass representing the shipping container.

d) The shipping container was supported on the trailer frame by two linear springs.

The low-bed trailer was leased from Bragg Equipment Co., Paramount, California. These minimum road-height trailers are designed to carry large, heavy loads and are rated at a nominal load capacity of 20 tons. The trailer axle suspension is of the spring-beam type and carries no shock absorbers.

The special routing required involves surface streets with a minimum (about 3 miles) of freeway routing. Road hazards such as railroad crossings, potholes, drainage dips, etc., occur and due to road traffic conditions, optimum road speeds over these hazards cannot always be achieved. Thus the lightly loaded, stiff, undamped trailer suspension system could also provide a rough-ride environment. It was, therefore, decided to install a shock isolation system between either the antenna and the shipping container, or between the shipping container and trailer bed. The shipping container/trailer bed installation was chosen for the following reasons:

- Installation of the isolators in the plane of the c.g. of the loaded container is easily accomplished, thus minimizing pitch and roll response.
- Overall weight of the container made use of inexpensive, off-the-shelf isolation hardware possible.
- Isolation system is easily accessable during installation, checkout, or repair.

<u>Recommended Shipping Configuration</u>

Description

Double drop 20 ton minimum load capacity trailer and dual axles and 10.00-22 tires. Tires pressurized to 75 psig.

e) The vehicles were supported by linear springs, one set representing the vehicle suspension systems, the other representing the tires.

f) All damping in the system was assumed to be viscous.

The mathematical model was analyzed for both spaced board and single board inputs at the wheels. Flexible body modes were obtained with the use of the TRWSAP computer code. Shipping container and trailer frame dynamic responses were determined with the use of TRNCAN, a general purpose computer code for determining the dynamic response of wheeled vehicles. Input data used for board course and single board runs were:

Parameter	Board Course	Single Board
Velocity of Transporter, inches/seconds	104.0 (5.9mph)	352.0 (20.0mph)
Board Width, inches	8.0	12.0
Board Height, inches	1.0	1.0
Board Spacing, inches	26.0	1200.0
Number of boards	8	2

The following configurations were investigated:

1) Loaded trailer with and without ballast weights.

2) Shipping container with and without isolator springs.

3) Shipping container with less than 1%, 10%, 20% of critical damping in shock absorbers.

Results indicated that the 4.0 Hz isolator springs are satisfactory provided trailer bed ballast and not less than 10% of critical damping in the isolator shock absorbers are used.

An instrumentation system consisting of six accelerometers, signal conditioning equipment, a magnetic tape recorder, and a motor generator set was carried on the trailer during transport of both antennas from Space

Park to Capistrano and return. Accelerations were recorded continuously during all runs. Data evaluation was obtained from low and high speed oscillographic runs as played back from the magnetic tape. Analysis indicated that base ring response could be lowered by a factor of 3.4 through the use of 20,000 lbs of ballast. Actual test indicated a reduction factor of 2.3. This agreement is considered satisfactory considering the many estimates which were used in the mathematical model.

Pitching of the shipping container resulted in impacting, or bottoming, of the shipping container air bag springs during transport of the qualification model antenna. This occurred during four road induced events during the trip. Resulting base ring response was 2.2g maximum. Comparison with board course data runs from the analysis indicated that an increase in damping was required. Since the natural frequency of the air bags is not changed radically by an increase in nominal air bag pressure, it was determined that 90 psi, rather than the 60 psi used, would increase the available spring travel by about 0.4 inches. Accordingly, during transport of the Flight One antenna, 90 psig was carried in the air bags, and the Volkswagen (Bug) shock absorbers were replaced with Monroe #6071 shock absorbers. The Monroes are designed for one ton truck service. The maximum base ring response seen during the trip was 0.9g and occurred during one event only.

The maximum response measured on the truck bed during the shipment of the Flight One antenna occurred during a wheel bounce event at about 11 Hz, inducing a 2.1g response in the truck bed. Truck bed response due to wheel bounce is usually the highest response induced in wheeled vehicles. Base ring response was 0.5g. The resulting attenuation factor of 4.7 is reasonable for the shock absorbers used.

Summary

Dynamic response measurements were recorded during highway shipment of the following antenna from Space Park to the Capistrano test site

(1) FLTSATCOM UHF Transmit Antenna - Qualification Model

(2) FLTSATCOM UHF Transmit Antenna - Flight I Model

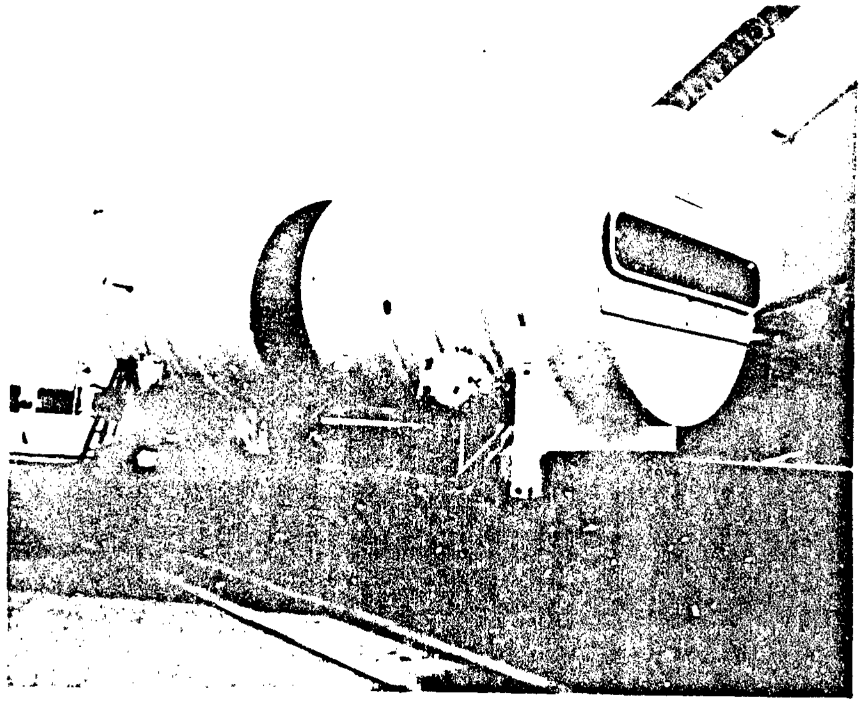
The maximum acceleration measures at the base of the Flight I Antenna was 0.9g at a frequency of about 3.5 Hz. This response was induced by a road surface irregularity, was transient in nature, and was quickly damped out.

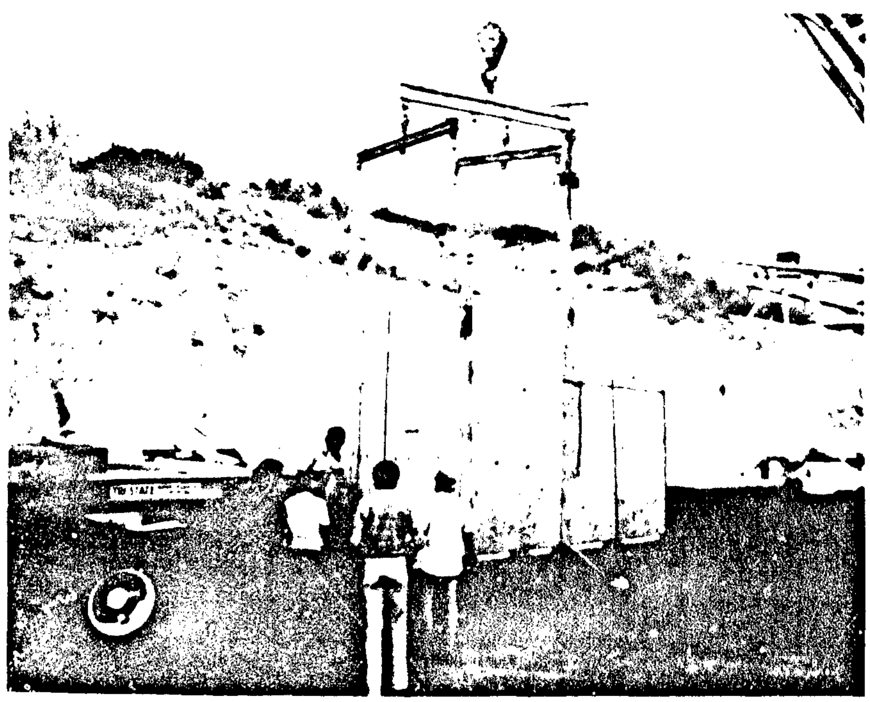
In addition to road measurement, the Qualification Model Antenna, as installed in the transporter, was subjected to a known input to verify the results of a dynamic analysis of the transporter. The input consisted of passage over a 1 inch x 12 inch x 10 foot board at a vehicle speed of 20 mph. Acceleration at the antenna base measured approximately 0.4g which agreed satisfatorily with analytical results.

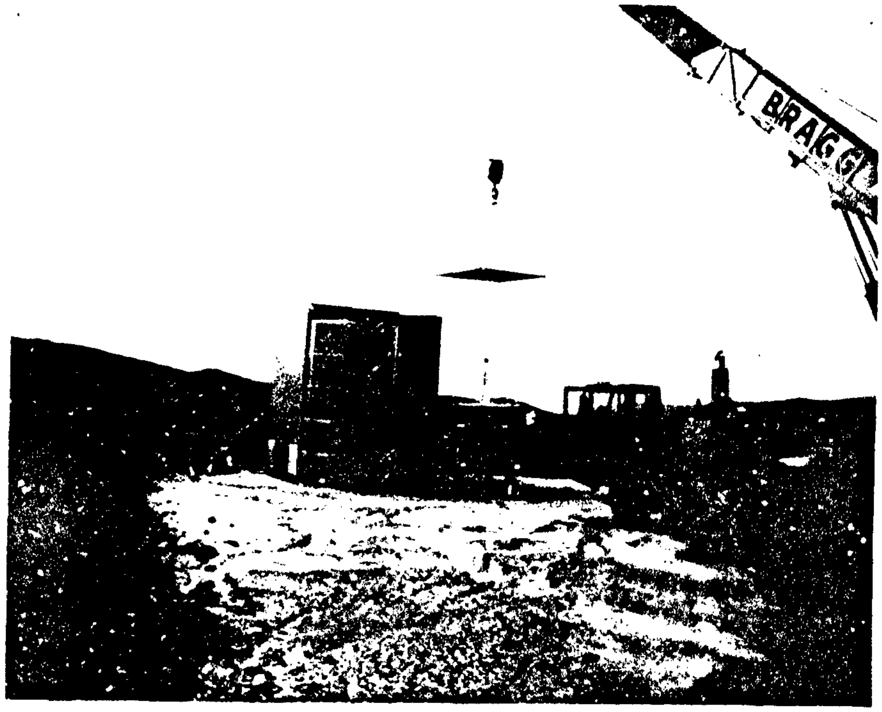
Ladies and gentlemen, it has indeed been my pleasure to share some of our concerns with you this morning.

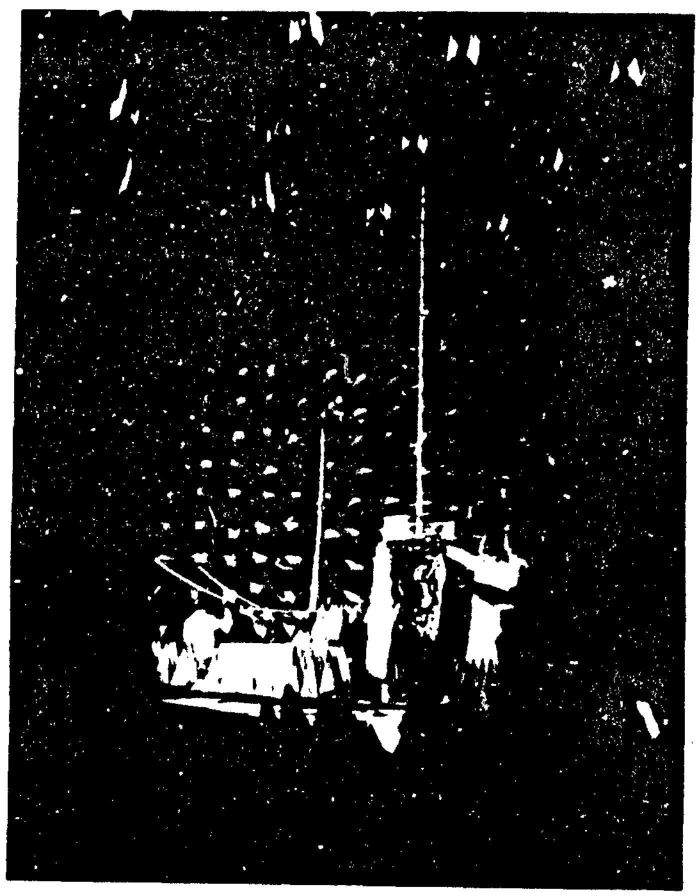
Thank you.

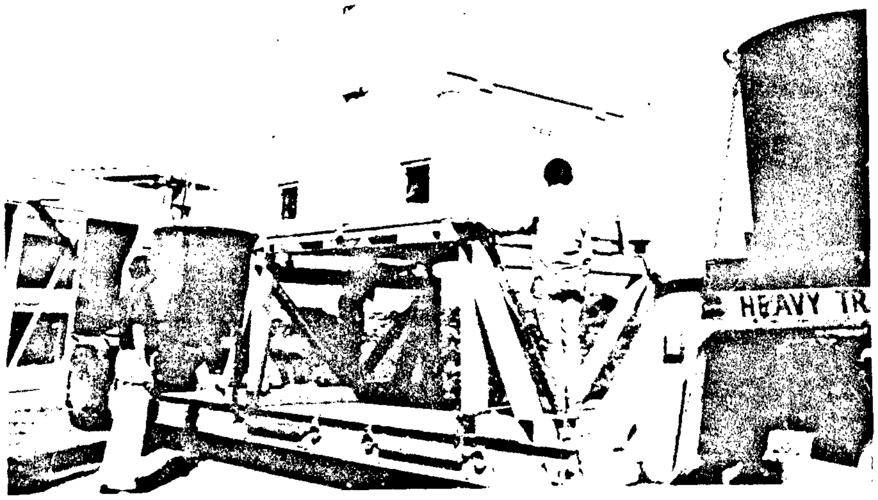
Are there any questions.

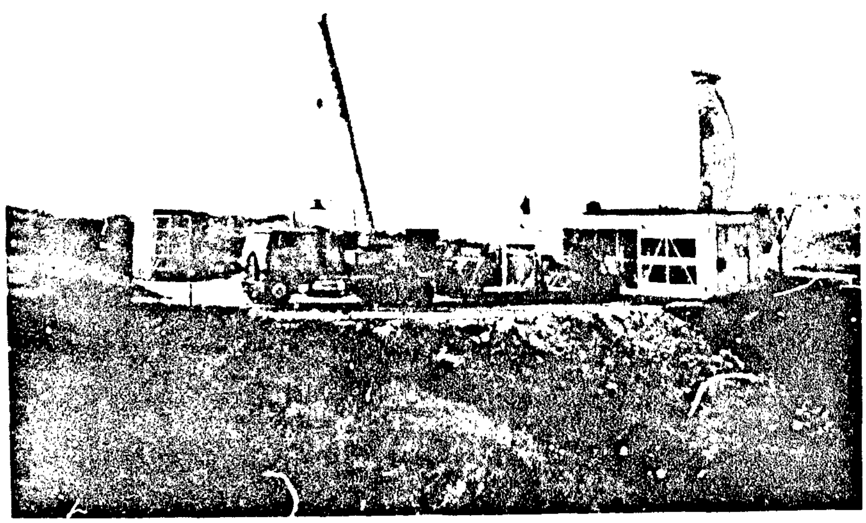





BRAGG




HEAVY TR



LOGMARS UPDATE
Mr. Frank Guerrero
DCASS, Defense Logistics
Agency, Cameron Station,
Alexandria, Virginia

I HAVE BEEN ASKED TO PROVIDE A BRIEF UPDATE ON THE LOGMARS PROGRAM FROM THE CONTRACT ADMINISTRATION (CAS) POINT OF VIEW. IN OUR POSITION, WE HAVE BEEN EXPOSED TO A WIDE VARIETY OF IMPLEMENTATION PROBLEMS FROM BOTH THE CONTRACTOR'S AND THE GOVERNMENT'S VIEW.

LAST WEEK, A WORKING GROUP MET AT TOBYHANNA ARMY DEPOT TO PUT THE "FINISHING TOUCHES" ON PROPOSED CLARIFICATIONS TO THE LOGMARS CONTROLLING DOCUMENTS, MIL-STD-129 (MARKING) AND MIL-STD-1189 (SYMBOLOGY). I SHOULD STATE HERE THAT THESE CHANGES ARE ONLY FOR THE PURPOSE OF IMPROVING THE LANGUAGE IN THE TWO STANDARDS SO THAT BOTH GOVERNMENT AND CONTRACTOR PERSONNEL WILL HAVE A CLEARER UNDERSTANDING OF THE INTENT OF THE PROGRAM'S APPLICATION. INTERPRETATION DISAGREEMENTS HAVE BEEN A CONSTANT STUMBLING BLOCK IN ADMINISTERING THE PROGRAM IN CONTRACTS. LESS YOU GET THE WRONG IMPRESSION, HOWEVER, LET ME ASSURE YOU THAT THERE IS A GOOD WORKING RELATIONSHIP AMONG THE LOGMARS COORDINATING GROUP MEMBERS REPRESENTING EACH OF THE SERVICES/DLA.

WITHIN DCAS, WE IN THE CONTRACT ADMINISTRATION DIRECTORATE CONTINUE TO WORK CLOSELY WITH THE QUALITY ASSURANCE DIRECTORATE. WE HAVE HAD GOOD SUCCESS IN RESOLVING MANY CONFLICTS OF INTERPRETATION IN THE FIELD. I BELIEVE THAT THE CHANGES NOW BEING INCORPORATED INTO THE STANDARDS WILL GO A LONG WAY TO ELIMINATE THE TYPE PROBLEMS WE'VE EXPERIENCED IN THE PAST NINE MONTHS. WHAT ARE SOME OF THE QUESTIONS STILL BEING RAISED?

A. DOES THE IN-THE-CLEAR INTERPRETATION, WHICH IS IN OCR-A STYLE, HAVE TO BE MACHINE READABLE?

NO. HUMAN READABLE ONLY.

B. DO I HAVE TO HAVE A LARGER (HEIGHT) BAR CODE ON THE SHIPPING CONTAINER THAN I DO ON THE UNIT/INTERMEDIATE CONTAINERS?

NO. THE ONE-SIZE, DOWN TO .25 INCH HEIGHT, IS SUITABLE FOR ALL CONTAINERS. PARAGRAPH 5.2 OF MIL-STD-1189 WILL BE CHANGED, DELETING THE 1.25 IN DIMENSION.

C. DO I HAVE TO ENCODE THE 4-DIGIT ORDER NUMBER?

IF YOUR EQUIPMENT CAN HANDLE IT, WE WILL ACCEPT IT, BUT WE ARE NOT GOING TO MANDATE IT, AT THIS TIME. A NOTE OF CAUTION HERE: THE SERVICES/DLA HAVE ASKED TO ADD THE 4-DIGIT ORDER NUMBER, WHEN APPLICABLE, TO THE CONTRACT NUMBER. THIS CHANGE WILL PROBABLY BE APPROVED IN THE NEAR FUTURE.

D. MY EQUIPMENT AN RUN THE OCR-A WITH SPACES BUT SUPPRESS THE SPACES IN THE BAR CODE. CAN I PRINT MY LABELS IN THIS FORMAT?

YOU MAY BAR CODE 13 DIGITS AND PROVIDE 17 DIGITS IN THE CLEAR IF YOUR EQUIPMENT PERMITS, BUT YOUR CERTIFICATION MUST EXPLAIN THIS CLEARLY, SO THAT THERE IS NO CONFUSION OR DOBUT. THE SAME CAUTION APPLIES IF YOUR EQUIPMENT SEPARATES THE NSN INTO ITS COMPONENT PARTS.

E. DO I HAVE TO PROTECT THE BAR CODE MARKINGS ON PRE-PRINTED, LEVEL B, FIBERBOARD SHIPPING CONTAINERS?

YES, THE SAME AS YOU WOULD PROTECT THE LABEL.

F. CAN I REPRODUCE (BY PHOTOCOPY) THE BAR CODE?

THERE IS NO DIRECT PROHIBITION; HOWEVER, IF YOU DO SO, YOU BECOME THE LABEL MANUFACTURER, AND MUST BE ABLE TO PROVE, I.E., CERTIFY THE BAR CODE, AS TO ITS ACCURACY AND READABILITY!

G. MY PACKAGE SIZE IS SMALLER THAN 2-1/2 X 3 INCHES. DO I STILL HAVE TO APPLY BAR CODE MARKINGS?

GENERALLY, YES. SOME BUYING ACTIVITIES MAY EXEMPT PACKAGES THAT ARE SMALLER THAN THESE DIMENSIONS BUT WE ARE NO LONGER USING ANY EXEMPTIONS BASED ON SIZE. YOU WILL HAVE TO READ YOUR CONTRACT TERMS CAREFULLY. IF YOU ARE NOT SURE, CHECK WITH THE QUALITY ASSURANCE SPECIALIST OR THE PACKAGING SPECIALIST.

TO FACILITATE COMMUNICATION WITH CAS PACKAGING SPECIALIST, THE MINUTES OF THIS SPRING MEETING WILL INCLUDE A LIST OF THE CAS PACKAGING POINTS THAT YOU MAY CONTACT AT EACH CAS RGION OR MANAGEMENT AREA OFFICE.

I HAVE MERELY TOUCHED UPON SOME OF THE MORE FREQUENTLY ASKED QUESTIONS AND PROPOSED CHANGES.

I WILL BE GLAD TO TRY AND ANSWER ANY QUESTIONS YOU HAVE AT THIS TIME.

CURRENT LIST OF DCAS PACKAGING SPECIALISTS

ATLANTA:		P. Cox	404--429-6315
	Atlanta	E. Lloyd	404--429-6062
	Birmingham	W. Currie	205--254-1369
	Orlando	T. Brandenberg	305--896-9184
BOSTON:		E. Fallon	617--451-4250
	Boston	D. Tiney	617--451-4135
	Bridgeport	D. Evans	203--579-5532
	Hartford	E. Colby	203--722-3570
	Syracuse	F. McClelland	716--263-6450
CHICAGO:		J. Gay	312--694-6472
	Chicago	T. Chorvat	312--694-6888
	Indianapolis	T. J. Florea	317--542-4347
	Milwaukee	J. Hipps	414--272-8282
CLEVELAND:		I. Headley	216--522-6733
	Cleveland	D. K. Roche	216--522-5375
	Dayton	D. Woods	513--296-6603
	Grand Rapids	V. Keim	616--456-8642
	Ottawa	E. Driscoll	613--992-1925
	Detroit	J. Wells	313--226-5023
DALLAS:		W. Oliver	214--670-9414
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	San Antonio	E. Arismendez	512--229-1236
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	Inglewood		213--643-2701
	Van Nuys	M. Luetje	213--977-3339
	Santa Ana	R. Solar	714--836-2788
	San Francisco	M. Cullen	415--876-9554
	Seattle	G. Martinez	206--527-3961
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	Garden City	M. Boscelli	516--228-5872
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